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BLUEPRINT READING

INSTRUCTION PAPER

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BLUEPRINT READING

INTRODUCTION

Definition of Blueprint. A blueprint as used by engineers and by workmen in the various industries is a reproduction of what is known as a *working drawing*. A working drawing, as made by the draftsman, shows by means of lines what the piece, machine, or construction is, gives the necessary working dimensions and whatever other data the workman needs to know in order to build the piece or the structure; in other words, it is the drawing by which the workman does his work and to which he looks for his information when building the structure or machining the part. However, it is essential that the working drawing itself be preserved for reference in the drafting room, and therefore a blueprint is made from the working drawing and this is what the workman uses at his machine or in the field. The lines, numerals, and letters on the original working drawing are black on a white background but these appear on the blueprint as white lines on a blue background; hence the name *blueprint*.

Process of Making Blueprints. Blueprints are contact prints; that is, the blueprint paper and the working drawing are in contact with each other while exposed to the light. Blueprint paper is a strong rather tough white paper coated with a solution which is sensitive to sunlight and turns blue when exposed to sunlight and then washed in clean water. Those firms which use large numbers of blueprints often coat their own paper. Most firms, however, buy it in the open market already coated with the prepared sensitive solution. In making a blueprint, the working drawing is laid face down on a sheet of clear glass and the blueprint paper, cut to a size slightly larger than that of the drawing, is laid on the drawing with the colored, or sensitive, side next to the drawing and by means of a clamping frame is brought and held firmly in close contact with the drawing. The holding frame is then tipped and held in a position to allow the sun or other strong light to shine squarely through the glass. The light thus passes through those parts of the drawing on which there is no ink and effects a chemical change in the light-sensitive blue coating. The light does not shine, or pass, through the inked lines of the drawing, the lettering, or the numerals. After a short exposure to a strong light the clamps are removed and the blueprint paper is taken out of the frame and thoroughly washed in clean water. The parts upon which the strong light shone turn a rich blue color; those parts which came under the inked lines were not affected by the light rays and wash up a clean sharp white.

Importance of Blueprints. The blueprint from a properly made working drawing should contain *all* the information needed by the workman in his work and he should never ask for information until he is positive that it is not on his blueprint. It is well also for him to understand that his blueprint is an exact reproduction of a drawing on file in the drafting room and that, if he implicitly follows instructions and dimensions as given in his blueprint, he is protected in any argument which occurs over his work; in other words, if his work checks up with the blueprint he has worked from, any errors found in results are squarely up to the draftsman.

What Blueprints Should Show. A blueprint is in a sense a picture of the piece, machine, or structure which is to be made or built. This picture is made up of views; for example, front view, top view, end view, etc. (See "Mechanical Drawing," Part III, pages 73–79.) These views are made up of lines which would show clearly to the eye if the part, machine, or structure were viewed from the several positions noted; for example, a front view consists of those lines which would be clearly seen if the observer were viewing the part or machine from the front. The blueprint should also contain all the essential dimensions and indicate clearly from what surfaces they are to be taken In most cases, this is done by using a distinct arrowhead with the point resting against the line which represents the surface or the outline from which the measurement starts or from such a working line *extended;* that is, the line which represents a surface edge is lengthened to make it convenient for placing the arrowhead. Another arrowhead is placed against the line representing the surface where the measurement stops, and the two arrowheads are connected by a line called a dimension line and the given dimension is placed either in this line or directly over it. Fig. 1 shows this. The blueprint will probably also contain lettered directions; some surfaces are to be ground, and the word "grind" may be lettered on those surfaces, others are to be polished, and on those the word "polish" may be placed.

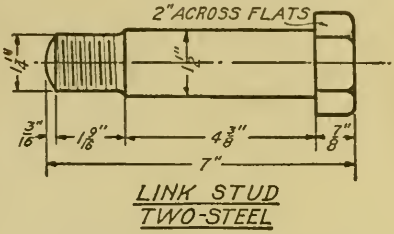


Fig. 1. Detail Drawing of Link Stud

Reading Blueprints. To be able to read a blueprint is as essential to a workman's success as to be able to read printed matter. To read blueprints readily, he must know some of the principles of making drawings. These are explained to a considerable length and with close attention to detail in "Mechanical Drawing," Parts I, II, and III, and these books should be read most carefully. This is somewhat equivalent to learning the alphabet in learning to read printed text. The workman should first understand that a blueprint is a record of instructions given him to read. Second, he should realize that the language used by the draftsman in making his drawing is largely a language of lines and that, unless he knows how to read lines, the instructions recorded on the blueprint are essentially in a foreign language. (Read carefully and memorize page 41, "Mechanical Drawing," Part II.) To read a blueprint, the first thing is to study the several views until one has a good mental picture of what he is to construct. As the blueprint is a flat surface, it is necessary for the workman to use his imagination to make the lines and views lift up from the paper. When a clear-cut mental picture has been formed, the dimensions should be studied until understood. Next all the lettered text should be read and considered. Carelessness in any one of these three respects is not to be excused.

GENERAL DIRECTIONS FOR READING BLUEPRINTS

Method of Obtaining Views. As already noted in the "Introduction," a blueprint represents the information which the draftsman is seeking to convey to the workman. It becomes necessary then for the workman to think somewhat as the draftsman thinks. Plate I, page 14, consists of three separate outlines, or diagrams.

These diagrams are known as views and are obtained by projecting the outlines of the piece point by point onto an assumed plane. (Read carefully the matter under "View" and "Projection" in "Mechanical Drawing," Part III, page 73, and study Fig. 95.) In the case in hand, the paper on which the drawing is made is the plane, and as the blueprint is an exact reproduction, line for line and point for point of the original, it also can be said to be the projecting plane. As an aid in understanding what the draftsman did when he made these *views* and why they are placed on the paper as they are, let the reader imagine that with a sheet of paper he has made a *box* having all the corners and all the sides square with each other. Assume that the paper box is transparent as glass is transparent and that a piece of work might be hung inside the box centered with the sides and corners. Let us now in imagination hang various objects one at a time in this paper box centered squarely with its transparent sides through which they may readily be viewed. (Carefully study Fig. 102, "Mechanical Drawing," Part III, page 79.) If the first object selected is a perfect cube, for example, an ordinary playing dice, then, viewing this from every side of the box, it is at once evident that all the views are the same in outline. If the outline dice is drawn, with a pencil, on each side of the box, as seen through that side, we will have six outlines all of the same size and shape. If an ordinary playing domino is substituted for the dice, the views when looking into the top and the bottom of the box will be alike in outline. Those seen when looking into the right and the left ends will also be alike, as will the views seen when looking through the back and the front sides of the box. If the pencil is used as before, six outlines are shown, but instead of their being each like the other, there are three pairs of views, each pair distinctly different from the others. If these penciled views are labeled top, bottom, front, back, right end, and left end, and the paper box is cut along its corners and the paper then tacked flat on a board, we have a drawing of the piece giving six views labeled top, bottom, etc.

Instead of doing all this box work, the draftsman first trains his hands as shown in "Mechanical Drawing," Part I, pages 22–29, to use in a neat and skillful manner the various tools shown and described in pages 1–17. He also trains his hands to produce and his mind to remember the various outlines shown in "Mechanical Drawing," Part II, pages 41–54. In addition, he must learn to imagine what he is going to make a drawing of, or, as it is termed, see the thing in space, which means form a reasonably complete *mind* picture of the piece he is to draw. In "Mechanical Drawing," Part III, pages 80–86, it is shown by what methods the draftsman avoids having to use a box with transparent sides when making a drawing; by using the tools shown in Part I, pages 1–17, in a certain conventional manner, he gets all the views he wishes on a sheet of paper tacked flat on a board.

Number of Views Needed. It will be recalled that in viewing the domino centered in the box, while we had six separate views, certain views duplicated and three views were sufficient to show clearly the outline of the piece. When drawn, some machine parts need several different views; others need only a single view. In Plate I the draftsman considered that he could get all the information the job needed on three views, namely, a front view a top view, and an end view.

Interrelation of Views. In reading Plate I and other blueprints, it will be observed that the top view and the front view center, line for line and point for point, on the same *vertical* center line, also that the front view and the end view center, line for line and point for point, on the same *horizontal* center line. Plate I, "Mechanical Drawing," Part I, page 26, shows a series of horizontal lines and a series of vertical lines, and it is explained in Part III, pages 73–86, how the vertical and horizontal reference lines work out in the drafting room. In some of the plates, it has been found necessary to readjust the different views to accommodate them to the small size plate, in violation of the rules of *third angle projection*. The student should make allowance for these discrepancies.

Meaning of Projection. To understand thoroughly what the term "projection" means, it is well to study the action of light as we view an object. Take as an example a man walking along the street. Our view of that man is made possible by the fact that light is *reflected* from his body into our eyes. This is true of all objects which we view with our eyes and we say that we *see* the man or the object. In other words, the light which is reflected, or thrown back, from the man or from the object into our eyes gives us a view of the man or the object. If the man or the object faces toward us, we get a front view, if away from us, a rear view. While the object itself is not a source of light, it is so treated in viewing it and the light is said to be projected from the object viewed. When a view drawing is made, it is often known as a *projection.*

Projection of House. In "Mechanical Drawing," Part III, page 118, Fig. 160, is shown an isometric projection of the ordinary house. As an example of *ordinary* projection, suppose we select such a house and view it from its several sides, at a distance of not less than 100 feet from the several sides. Taking the front end first, the viewer will note that it appears as a flat wall having a rectangular outline with its top line in the shape of an inverted V. A side view gives a bottom line where the house rests on the foundation, two vertical, or upright, lines at each end of the side, a horizontal, or level, line to show the eaves, and a second horizontal line above this to represent the ridgepole. If these two views have been penciled out on a sheet of paper to some exact size, they will show what the *outline* of the house is. We can also show on these views the several doors, windows, etc., as we see them when viewing the front end and when viewing one side of the house, and if the rear end and the opposite side have the same doors, windows, etc., in exactly the same positions, the workman would be able from these two views to construct walls which would be as desired. If, however, the rear end had the doors or the windows placed differently from those on the front end or if they were not of the same size even though placed in the same manner, the workman would need a rear view to show him this fact. The same thing would hold true in respect to the sides of the house. Also, if the roof itself were broken up by windows, a top view showing their size and layout would be necessary for the workman. For convenience in making and reading the drawing, the several views are universally arranged for shop use exactly opposite the surfaces which they represent, as noted in the use of the box with transparent sides.

Lines. *Working Lines.* A study of the views in the several blueprints in this book shows at once that each view is made up of straight lines and curved lines. The straight lines, or right lines (as they are often termed by draftsmen), are used to represent the edges of plane surfaces. How such lines are drawn and the tools used for drawing them are shown in "Mechanical Drawing," Part I, pages 22–25. In the example just used, two upright straight lines a certain distance apart would be used to show the corners of the house. A circle line may show the edges of a cylinder or a hole in any surface, for example, a bolt hole or, in a house, a circular window. By using a combination of straight lines and part of a circle, the rounded end of a straight-sided bolt, for example, can be shown. Where the edges are neither straight lines nor parts of a circle, they are drawn with a special tool having an irregularly curved edge, which can be fitted to the desired line shape. (See Figs. 32 and 33, "Mechanical Drawing," Part I, pages 16 and 17.) A view, then, may consist entirely of straight lines, entirely of curved lines or of circles, or of a combination of all these. It must in any case be clearly noted that any *working* line, straight or curved, is used to show where a surface on the work changes its direction, in other words, to show the *edge of a surface.* If the object viewed is a solid piece, for example, a bolt, all the working lines in the several views are solid and continuous straight or curved lines. If the work has holes through it or has hollow places hidden inside it, the lines which show the hidden edges are drawn as dots and the line is termed a dotted line. (See Fig. 110, "Mechanical Drawing," Part III, page 84.) In studying a blueprint then, it will be understood that the dotted lines in a view represent surfaces and edges which are hidden from the viewer's sight when the object is viewed from the side shown. In the case of the bolt, Fig. 1, a view of the head end would show the body of the bolt as a dotted circle. In a blueprint of the house, the wall timbers, partitions, etc., which are not seen from the outside, would be shown as dotted lines.

Dimension Lines. While the house outlines as they now stand give a general idea of how its exterior would look, they do not show its size or the sizes of the several doors, windows, trim, etc. To give this information, use is made of *dimension* lines drawn between points on the lines which make up the several views. To indicate the place where the measurement is to start and the point where it must stop, each end of a dimension line has a neat arrowhead, the point of which just touches the line at which the measurement starts or stops. Somewhere in the length of a dimension line are placed the numerals which give the exact measurement of the work as indicated by the arrow points. Dimension lines usually show on the blueprint much thinner than the lines which make up the views. This fact and the fact that at their ends are prominently placed neat arrowheads render it easy to avoid confusing them with the working lines of the blueprint.

In case a dimension line cannot readily be placed on the view, the working lines may be lengthened, or extended, a short distance from the view and the dimension line can then be drawn between the extended lines with the points of the arrowheads resting exactly against the extended lines. The end of an *extension* line, as it is called, should never quite touch the working line which it extends.

Section Lines. In addition to the working lines and the dimension lines on the blueprint views, the workman will, in some cases, find a series of parallel lines drawn closely together at an angle to the working lines of the view. These are known as *section* lines and are used by the draftsman to tell the workman that the part of the view covered by such lines is as if the work had been cut through and a portion removed. (Plate I, Fig. 3, "Mechanical Drawing," Part I, page 26, shows an example of section lines.) Sections open up the interior of an object or a combination of working parts, for example, the headstock of a lathe, and give a clear view of the inside. To use a homely illustration, the draftsman seeks the same effect as the grocer does when he cuts a melon in halves for the customer's inspection. A view so drawn is said to be *sectioned;* hence the term section lines. In the case of the lathe headstock, some of its parts may be of cast iron, some of bronze, some of steel, etc. To show which parts are of cast iron, of steel, or of bronze, the draftsman makes use of various arrangements of section lines, each arrangement showing a different material. In Plate III, "Mechanical Drawing," Part I, page 35, are shown and named the common arrangements of lines to show sections of different materials, viz, metals, wood, brick, concrete, etc. The workman should study those common to his work.

Drawing Sheet Sizes. In "Mechanical Drawing," Part I, page 2, is given a list of sizes of drawing sheets. While different shops may use different sizes for their blueprints, as a rule each shop has some regular system of sizes. A common system for machine shops makes the largest regular sheet 24″×36″ and lists it size A. Such a sheet will fold and cut to give two B sheets 18″×24″. Continuing the folding and cutting gives a C size 12″×18″; a D size 9″×12″; and an E size 6″×9″. A machine shop blueprint is usually trimmed to one of these sizes.

Methods of Showing Large Work. *Reducing Scale of Drawing.* Several methods are used to make it possible to show a view of large work on a small sheet of paper. The view is often made a reduced size, which is usually spoken of as making it to a *reduced scale.* The term "scale" in such a case means that the length of the working lines in the blueprint views has a definite proportion to that of the actual lines of the work itself; for example, if the circles which represented the rim of a 24-inch pulley were drawn in a view as 12-inch circles, the view would be one-half size, or to one-half scale. If the circles were made 6 inches in diameter, the view would be to one-quarter scale. While in these cases the dimension lines would be, respectively, 12 inches or 6 inches in length from arrow point to arrow point, the dimension figures would read the exact size, 24 inches. For the reason that a blueprint view on a reduced scale does not give the average workman a good *size* picture of the work, it is customary to have the views show the work to exact, or full, size whenever it is practicable to do so. Such a view is known as a full-size view, or a full-scale view. The common machine shop *view scales* are one-eighth, one-quarter, one-half, three-quarters, and full size. Another way of expressing view scales is in inches to the foot; for example, a one-half scale is 6 inches to 1 foot and a full scale is 12 inches to 1 foot.

Showing Parts of Work. Another way of getting a view of a comparatively large piece of work into a small space on a blueprint is to show only a part of the work in the view. In the case of the pulley just mentioned, if the blueprint view showed one-quarter or one-half of the entire pulley, the average workman would be able to get all the directions necessary from the view to complete the work.

Breaking the Piece. Yet another way by which the space utilized to represent a piece of work in blueprint views can be lessened is what is known as breaking the piece. To illustrate, use is made of the front view of a long bolt or shaft of relatively small diameter. If such a piece were shown full scale, its working length lines might reach the entire length of the blueprint or even farther. If the body of the bolt or shaft is of uniform size and shape, it is sufficient to show a portion of the body near the head and a portion near the threaded, or opposite, end, and the portions shown may be brought close up to each other and thus little space used for the view. When analyzing the several blueprints reproduced in the following pages, the ways in which space is utilized in representing the parts of the work will be noted.

Shade Lines. It must be admitted that the average blueprint view of a piece of work is a rather flat and dead thing and that some imagination on the part of the workman is needed to give it life and to make it lift up from the paper and really have form and substance. Fortunately for the machine shop workman who is just learning to read blueprints, much of his work comes to him roughly in the form in which he is to finish it. This is especially so when he is finishing ordinary castings. There are several methods used at times to give the blueprint views more "life". One much used method is to make certain of the working lines of increased thickness to represent a shaded portion. These heavier working lines are known as *shade* lines and aid somewhat in making the view stand, or lift, up from the paper. Such shade lines are used to a lesser extent now than formerly, as the workman is supposed to use his imagination when reading blueprint views.

Line Shading. The term *shade lines* should never be confused with the term *line shading* which refers to a decidedly different use of lines. Line shading as commonly used consists of a series of lines placed on the view within its working lines and arranged in such a manner as to give a picture effect to the view. In "Mechanical Drawing," Part III, pages 126 and 127, are shown a variety of objects which have been line shaded. Comparison of these illustrations with Figs. 78, 81, and 84, "Mechanical Drawing," Part II, pages 49 and 50, clearly shows what line shading does to liven up a view. As is the case with shade lines, line shading is used less in machine shop drawings than it formerly was.

Finish Lines. Another line used in blueprint views is sometimes termed a *finish* line. Such a line is usually broken up into dashes and dots and is then known as a *dashed* line. It is placed on the view close to a working line to indicate that the surface represented by the working line is to be finished. Dashed lines are now little used for this purpose because of the chance of their being confused with dotted lines used to represent hidden surfaces and edges, and other methods of indicating finished surfaces are popular. Brown & Sharpe practice is to use a red pencil to draw a full red line on the blueprint views close beside all working lines which represent finished surfaces. A common method of indicating finish is to place a letter *f* across all working lines which represent finished surfaces.

Symbols Used. There are a number of words which often appear on blueprint views, each conveying certain information, and the workman must be familiar with the more commonly used ones to read his blueprint readily. The word "ream" near a hole shown in the view means that the hole is to be finished by reaming it; the word "tap", if so placed, indicates that the hole is to be tapped. The terms which the workman is most likely to find on his blueprint views are ream, tap, grind, polish, scrape, frost, taper, crown, and drill. He will also often note the letters *F.A.O.* near certain views; when so found, they denote that the piece of work is to be finished all over and the letter *f* is left off the working lines. It is also common machine shop practice to place on the blueprint the name of the piece of work, the number wanted, and the material to be used, all neatly lettered. The several materials used in the construction of machinery are usually indicated by their initials, for example, *M.S.* for machinery steel. To read blueprints easily and accurately, the workman should learn the symbols used, the more common of which are given and defined in the following tabulation:

F.A.O.	finished all over	C.I.	cast iron
f.	finished surface	S.C.	steel casting
RAD.	radius	Bz.	bronze
DIAM.	diameter	C.R.S.	cold rolled steel
R.H.	right hand	T.S.	tool steel
L.H.	left hand	O.H.S.	open-hearth steel
P.R.	piston rod	W.I.	wrought iron
P. Tap	pipe tap	M.S.	machinery steel
CTRS.	centers		

Special notes neatly lettered are often placed on the blueprint and these notes should always be read carefully. In "Mechanical Drawing," Part I, pages 17–21, and Part III, pages 128–134, are shown examples of lettering. Each and every dimension line should have in clear distinct figures, either on the line or in a break in the line, the exact dimension which the dimension line represents. Dimension figures should be clear, distinct, and easily found and read. (Study Plate I, Fig. 4, "Mechanical Drawing," Part I, page 26.) Certain working variations in dimensions are allowable in all work. These are termed *tolerances* and should be given on the blueprint. They are usually preceded by the sign ± and are placed near or follow the given dimension. If the tolerances are not to be found, the workman must learn what the practice of the shop is in regard to this point.

Conventions Used. Certain conventions, as they are called, are often to be found on blueprints. Take screw threads as an example; they are seldom shown on a blueprint as actual threads but are *indicated* by an arrangment of parallel lines across the surface meant to be threaded, Fig. 1, page 3, and a note is usually lettered on or near the threaded surface giving the number of threads per inch and the form of the threads. Gear teeth are seldom shown on a blueprint; a lettered note is used instead to state the number of teeth in the gear and whether they are involute, cycloidal, or otherwise.

Intersections and Irregular Surfaces. While, in most cases, the workman can get the needed information from a sufficient number of views of the ordinary method of projection, this is not always true where two surfaces meet at an angle, especially if they meet or intersect at other than a right angle. As an example of such a case, take the spout of an ordinary tin coffee pot where it joins the body of the pot. In uniting the two, it is necessary to know just what the shape of the hole should be and its size; also, in making up the pot body and the spout body, each of which is usually tapered, it is necessary to know the exact shapes and sizes to which the sheet tin must be cut. All sheet-metal work is full of such problems, as well as work in leather, for example, shoe tops, bags, etc. To obtain the desired forms of the holes and the body of a sheet-metal object, it is in effect cut open and flattened out as if it were a sheet of paper. The methods by which such problems are solved are very clearly shown in "Mechanical Drawing," Part III, under the headings "Intersections," pages 98–106, and "Development of Surfaces," pages 106–113. While the workman's blueprint should show the already developed surface, or pattern, he will better understand his job if he knows how such a pattern is made.

Single Picture Views. The practice in some shops is to furnish the workman with a small blueprint which has a single view of the piece he is to work on. These sketches can be made by the use of the regular draftsman's tools or, given sufficient artist's skill, may be made free hand. The excellent examples of such sketches given in Plates XXIX, XXX, and XXXI were, in the original, entirely free hand. Where one view is sufficient to show an object in its true shape, it must show the object tipped and turned into such a position as to give a picture view. The sketch artist views the object from a variety of angles, finally decides which view best shows the piece, and makes that the blueprint view for the workman. In "Mechanical Drawing," Part III, pages 113–125, the methods used to obtain these single picture views are described and illustrated.

Importance of Careful Study. The careful reader of the preceding text must now be impressed with the need of *knowing* things. The way to know a thing is to study it, just as a child studies his book when learning to read. The child first learns the simpler words, how they look, what letters of the alphabet are used in spelling them, how the words are pronounced, etc. Anyone who is willing to study this text and "Mechanical Drawing," Parts I, II, and III can learn how to read ordinary blueprints readily. To assist the reader of this text in doing this, a variety of simple blueprints have been selected for analysis. Although they by no means cover all classes of work, nevertheless, they have been selected from a large number as being the more typical of their kind. Carefully study each blueprint as well as the text, for, in the first place, you will become acquainted with good practice as carried out by several well-known firms and, in the second place, you will, by this thorough analysis, train yourself to see in any blueprint everything that was intended to be brought out.

ANALYSIS OF TYPICAL BLUEPRINTS

PLATE I

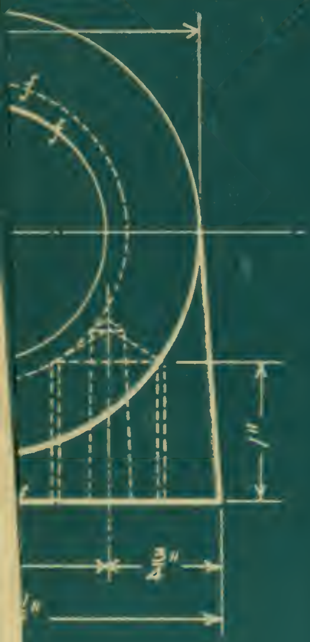
SADDLE NUT

It is evident that Plate I shows three views of a saddle nut. Before starting to read the views, the workman should read the lettered data at the top of the blueprint. From this he gets the name of the piece he is to make, "saddle nut," the number required, "one, on a single machine," the name of the machine to which the piece belongs, "5-foot boring mill," and the piece number, "14049." He next reads the lettered data at the lower edge of the blueprint and learns what material he has to work on, in this case, bronze. If this plan has been followed out, the workman now knows that he is to make a certain number of bronze saddle nuts, each of which is a part of a 5-foot boring mill.

The several views are a front view, a right end view, and a bottom view. The front view shows the piece as it would look when set on its flat base on the bench, with its long side toward the viewer. The right end view shows the piece as it would appear if set on the bench as before, but so placed that the right end would face the viewer as he stood at the bench. The remaining view shows the bottom, or base, of the piece as it would appear if the workman picked the piece up from its first position on the bench, held it above his head, and looked up at its bottom side. As both ends of the saddle nut are alike, no left end view is necessary; and as nothing is to be done to its upper, or top, surface or to its rear side, neither a top nor a rear view is necessary.

The dotted lines through the front and the bottom views show that there is a hole through the length of the work and the right end view shows that the hole is circular in shape. As the dotted lines through the front and the bottom are double lines exactly centered with the center lines of these two views and as the right end view shows a full-line circle and a dotted-line circle, something more than these lines are needed to tell us just what this hole is. Between the front view and the right end view are certain notes nicely lettered. They state that the hole has a left-hand square thread, four threads to the inch through its length,

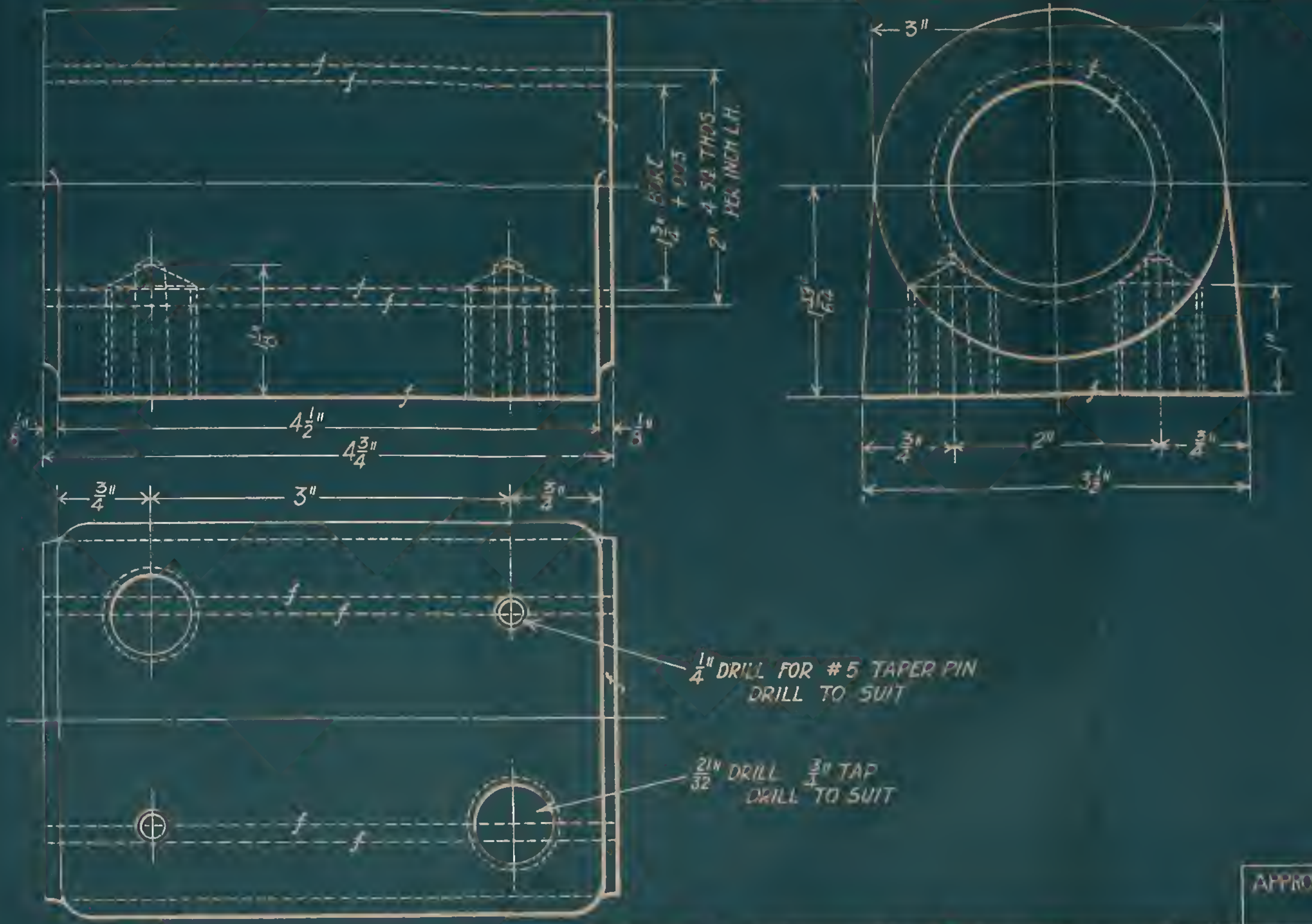
E OF MACHINE	PIECE NO.
ET BORING MILL	14049



APPROVED BY

ATT. NO.	SIZE	LENGTH	PIECE NO.
			14049

NAME OF PIECE	AMT. REQ	NAME OF MACHINE	PIECE NO
SADDLE NUT R.H. HEAD	1	5 FT BORING MILL	14049



1/4" DRILL FOR #5 TAPER PIN
DRILL TO SUIT

21/32" DRILL 3/4" TAP
DRILL TO SUIT

APPROVED BY

14019

GROUP NO	TRACED BY	DATE	CHECKED	THE CINCINNATI PLANER CO.	MATERIAL	USE PATT. NO.	SIZE	LENGTH	PIECE NO
14011	R Sillhaus	4.17.17.	F.A.		BRONZE				14049

make everything clear as to what the hole is, and explain the name "nut" given to the piece in the title.

Near the base of the front and the right end views are certain other dotted lines which, of course, represent hidden surfaces or holes. When we look at the bottom view, it is easily seen that these are round holes. By reading the notes placed at the right of this view and by following the arrows, we learn that two of these holes are to be made to fit a No. 5 taper pin and that the two larger ones are to be drilled and tapped for a $\frac{3}{4}$-inch screw. This view also shows that there is a screw hole and a pin hole in each end of the piece and that the screw and the pin holes are placed in corners diagonally across from each other. It can also be seen by reference to the several views that the screw holes and the pin holes are placed on the same center lines. If the workman is used to general machine construction, he will know that the screw holes are for the bolts which are to hold the saddle nut to the saddle and that the pin holes are for the taper pins which locate and hold the nut to an exact position. The bottom view shows by dimension lines placed just above the view that the holes are to be placed 3 inches from each other along the length of the piece and $\frac{3}{4}$ inch in from the edges of the base. The end view shows by dimension lines placed just below the view that along the width of the piece the holes are 2 inches apart and $\frac{3}{4}$ inch in from the sides. The workman should understand that when the dimension lines are shown in this manner, the *center-to-center* distance is the more important one. In this case, the 2-inch and the 3-inch dimensions are of more importance that the $\frac{3}{4}$-inch dimensions, these latter being probably given to inform the workman that the holes must be symmetrical with the base of the nut.

Attention is called to the placing of the dimension lines between or at the side of the views and to the fact that the arrow points touch extension lines drawn to nearly touch the surface lines. Dimension lines placed between the front view and the bottom view show that the saddle nut is $4\frac{3}{4}$ inches long over all and that the over-all length of the base is $4\frac{1}{2}$ inches. Dimension lines placed just below the right end view show that the base of the nut is $3\frac{1}{2}$ inches wide over all. A dimension line placed just above the end view shows that the rounded part of the nut is 3 inches. While reading the over-all dimensions, for example, the 4¾-inch, the 3½-inch, and the 3-inch dimensions, the workman should at the same time see whether or not his castings measure up fairly close to these dimensions with finish allowances.

Attention is called to the fact that all the dimensions are given either in whole numbers or in whole numbers and common fractions, with the exception of the dimension for the bore of the hole, which has added to it the decimal 0.003. This would indicate that the various dimensions given, with this one exception, are not of exceptional importance, or that the workman will be furnished with a special gage, or that the work will be jigged.

In this blueprint, it will be noted that the surfaces to be finished are indicated by the letter *f* placed on the working surface lines. As thus indicated, the base of the nut, the right-hand end, and the hole through the nut are to be finished.

PLATE II

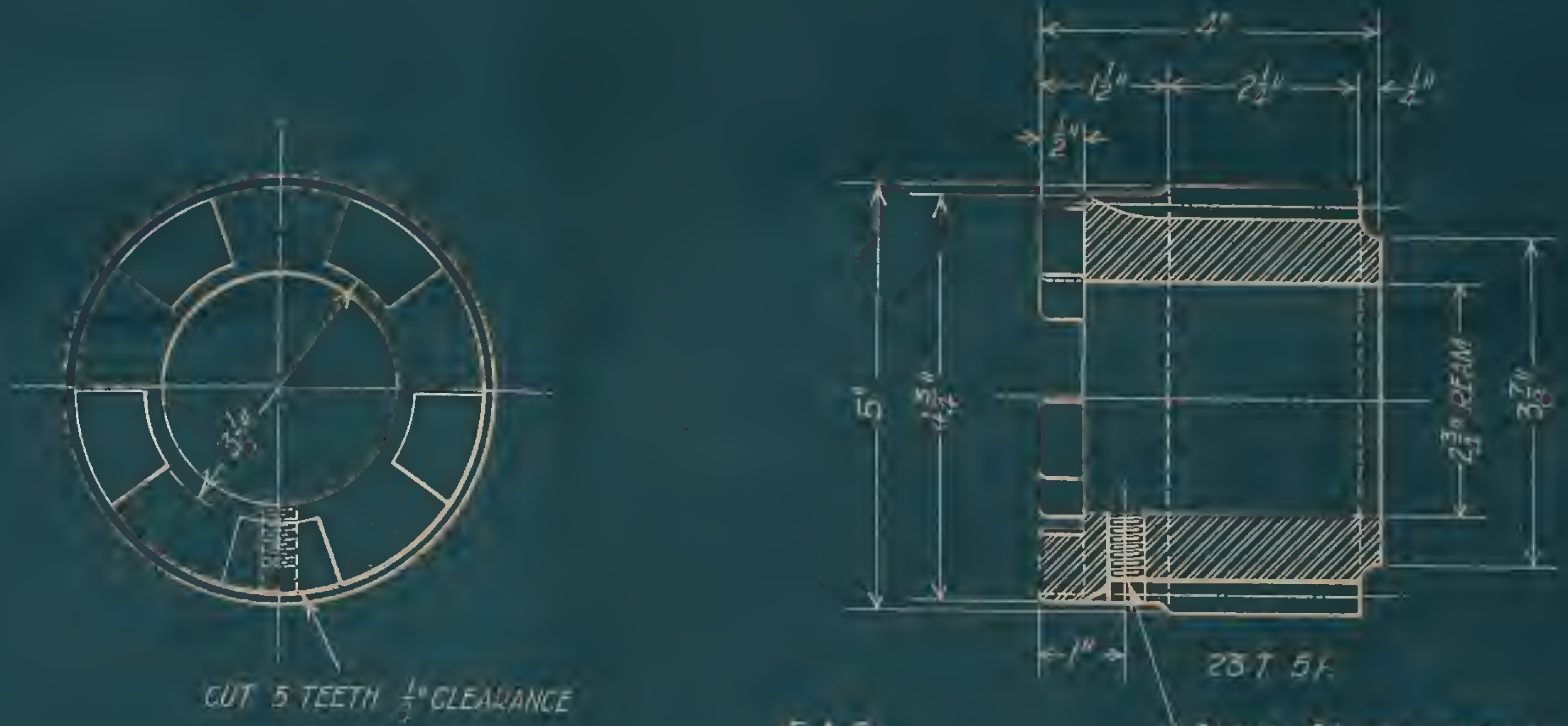
BACK CLUTCH PINION

The lettered data at the upper edge of Plate II informs us that the piece is a back clutch pinion for a 5-foot boring mill and that one is required on each boring mill. Lettered data also tells us that the material is machinery steel and that the rough stock is 5⅛ inches in diameter and 4⅛ inches long.

The views given are a front view and a left end view. As the work is round with a plain squared-up right end, two views, as shown, are sufficient for the workman to understand what the piece is as well as to get all his dimensions. As an aid in reading the blueprint, the front view shows the piece as if it had been cut in halves through its length. The parts of this view which show where the cutting is made in solid stock are cross-lined at an angle of 45 degrees with the working lines. Referring to "Mechanical Drawing," Part I, page 35, it is seen that the cross-section lines are arranged to show that, as previously stated, the material is machinery steel.

As the first machine operation on this piece of work is that of getting a hole chucked through its axis, or length, the workman will naturally read his drawing for the size of the hole. At the right hand of the front view we find a dimension line with the

NAME OF PIECE	AMT. REQ.	NAME OF MACHINE	PIECE NO.
BACK CLUTCH PINION	1	5 FT BORING MILL	14141



F.A.O.

								APPROVED BY	
GROUP NO.	TRACED BY	DATE	CHECKED	THE CINCINNATI PLANER CO.	MATERIAL	USE PATT. NO.	SIZE	LENGTH	PIECE NO.
14004	A-i	5.3.17	F.a.		M.S.		5 1/8"	4 1/8"	14141

11

arrow points touching the diameter lines of the hole extended, as explained in "General Directions for Reading Blueprints." The figures placed in the dimension line inform us that the hole is to be made 2¾ inches, and as the left end view shows a central circle, the hole is a round one. The word "ream" placed on the dimension line to the right of the dimension figures shows that the hole is to be drilled sufficiently small to permit it being reamed to its exact figured size. This dimension, as well as all the other dimensions, in the original blueprint, read two times the actual distance between the arrow points as shown on the views. The views in the original blueprint are then one-half the size of the actual piece of work and are drawn to one-half scale, in other words, 6 inches on a view represents 12 inches on the actual work.

The next two machine operations on this piece are to square the ends to the over-all length and to turn and finish it to the exact diameter. By following the end extension lines upward, we find at their upper ends a single dimension line having arrowheads with their points touching the extension lines. By reading the numeral placed in the line, it is found that the over-all length is 4 inches. Thus far this blueprint is very easily read.

Before starting work on the diameter, the views and the lettered text must be more carefully read. The name of the piece, "back clutch pinion," and a study of the views show it to be a gear with a clutch on its left-hand end.

Following out the extension lines to the left and to the right of the front view, which represent the several working diameters, we learn that the surface where the gear teeth of the pinion are to be cut is 5 inches in diameter. By following the upward extension lines, it is seen that the right-hand ends of the teeth do not start at the exact end of the stock but ¼ inch to the left of this. The extension lines also show by proper dimension lines that the faces of the teeth are to be 2¼ inches long. In this same view, the upward extension lines and dimension lines show that the remaining length of the piece from the left-hand end of the pinion teeth is 1½ inches. Following the diameter extension lines to the left, we learn that the diameter of this part of the work is 4¾ inches.

A further study of the *left* end of the *front view* and of the *left end view* will show that the inner diameters of the clutch teeth are counterbored out to 3⅛ inches with a depth of ½ inch. The right-hand end of the work is turned into the form of a hub having, according to the dimension line near that end, a small diameter of 3⅞ inches but curving up into a fillet. Both views show that there is a tapped hole through one side of the piece, and the lettered data placed just below the front view tells us that the hole is to be drilled with a $\frac{5}{16}$-inch drill and tapped with a ⅜-inch tap. Both views show the clutch teeth.

In the left end of the front view, extension lines carried upward have dimension arrowheads and numerals which show that the clutch teeth are to be cut ½ inch deep. The left end view shows the general form of the clutch teeth. A lettered note just below this view states that there are to be five teeth and that the spaces between the teeth are to be ⅛ inch wider than the teeth themselves. This indicates that the teeth in the mating part of the clutch and the teeth in the piece shown in this blueprint will, when in mesh, clear each other by a distance of ⅛ inch. A lettered note placed just below the front view informs us that the gear teeth are twenty-three in number and that a five-pitch cutter is to be used in cutting them.

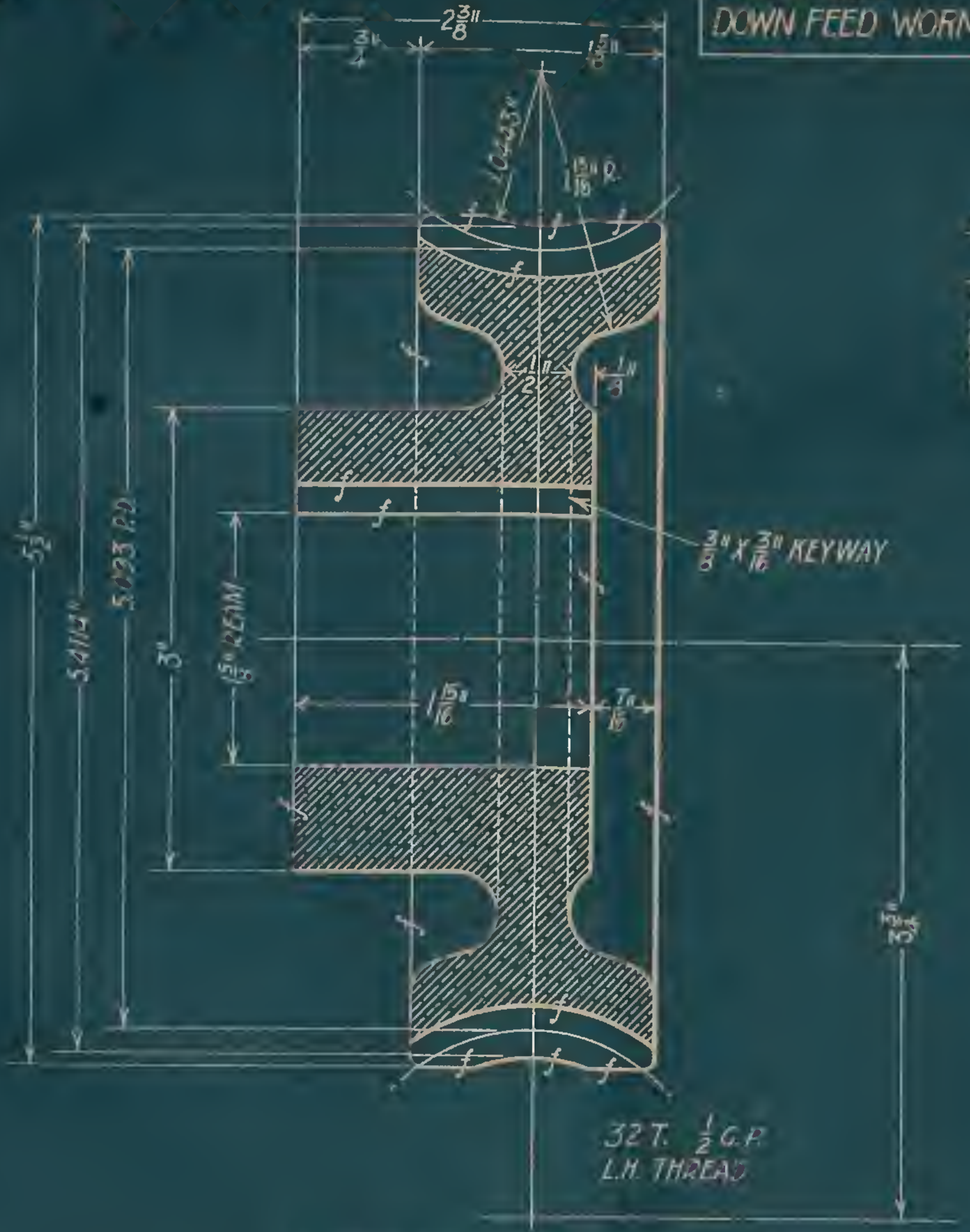
No finish *f* marks are placed on the various working lines in either view, but a lettered note *F.A.O.* tells us that the piece is to be finished all over. Two dotted lines on the front view indicate that there are hidden surfaces—in this case, the right-hand and the left-hand ends of the gear teeth of the pinion. If this text has been carefully studied, the reader will readily understand that Plate II really represents two pieces of work made solid in one piece of stock, namely, a toothed clutch and a pinion gear.

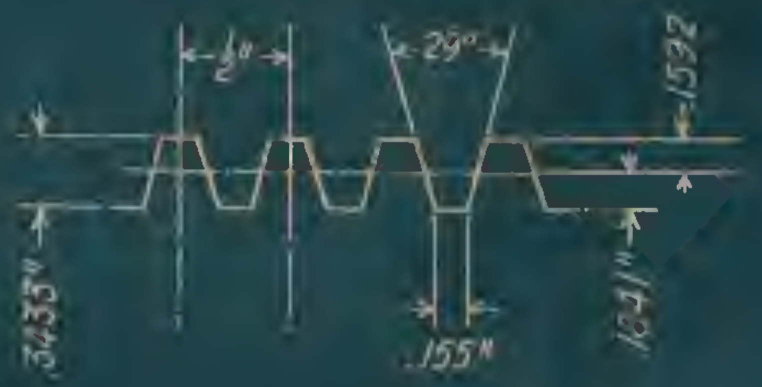
PLATE III

DOWN-FEED WORM WHEEL

In reading Plates I and II, it will have been noted that in Plate I three views were needed to show the workman all he needed, while in Plate II two views were sufficient. In Plate III a single view shows all that is needed to build this piece of work completely. The data on the upper edge of the blueprint states that the piece represented is a down-feed worm wheel for the right-hand head of a 5-foot boring mill and that one is required. The

NAME OF PIECE	AMT. REQ.	NAME OF MACHINE	PIECE NO
DOWN FEED WORM WHEEL R.H. HEAD	ONE	5 FT BORING MILL	14061





APPROVED BY

111

GROUP NO.	TRACED BY	DATE	CHECKED		MATERIAL	USE PATT. NO.	SIZE	LENGTH	PIECE NO.
14011	R.Gillhaw	4-19-17	F.A	THE CINCINNATI PLANER CO.	BRONZE				14061

data on the lower edge tells us that the material is bronze, which is also indicated by the arrangement of lines in the cross-sectioning of the view.

A worm wheel is a toothed gear with the gear teeth cut at an angle with the sides of its rim. This angle is such as will make its teeth readily mesh, or fit, into the screw threads of the worm which is used to drive it. While the driving worm is not shown on this blueprint, a dimension line at the right of the view, with one of its arrow points touching the center line of the worm wheel and the other touching another center line drawn near the lower edge of the blueprint, shows that the center-to-center distance of the worm and the worm wheel is $3\frac{3}{4}$ inches. Lettered data near the lower center lines states that the worm wheel is to have thirty-two teeth of $\frac{1}{2}$-inch circular pitch and that the worm will have a left-hand thread, two threads to the inch.

In reading Plate III, let us first study the view itself. We will see that it is the view seen by a viewer facing the central axis of the piece and is, therefore, a front view. Lines drawn on the view at an angle with the working lines show that it is a sectional view, the piece having been cut along the center of its length precisely as a watermelon is sliced along the center of its length. Since the view is shown in this way, it is somewhat easier to read. The fact that one view only is given to work from indicates: (a) that if the work were viewed from its ends, the views would show on the blueprint as circles; and (b) that the ends of the work are plain and squared up—hub and rim. The lettered data, as already noted, states that the piece is a toothed gear wheel. Altogether, the piece is shown to consist of a hub, a rim, and a connecting web.

Following the upward extension lines and the dimension lines which they carry, it is seen that the over-all length of the piece is $2\frac{3}{8}$ inches and that the rim width is $1\frac{5}{8}$ inches. The upward extension lines and their dimension lines also show that the worm wheel hub extends, or projects, to the left of the rim a distance of $\frac{3}{4}$ inch. Dimension lines on the body of the view show: (a) that the wheel hub is $1\frac{15}{16}$ inches long; (b) that the rim overhangs the right end of the hub $\frac{7}{16}$ inch; (c) that the right end of the hub projects $\frac{1}{8}$ inch beyond the web; and (d) that the web is $\frac{1}{2}$ inch thick. Following the extension lines to the left of the view, we learn that the hub is 3 inches in diameter and that the chucked hole in the hub must ream $1\frac{5}{8}$ inches. These extension lines also show that the over-all diameter of the toothed rim is $5\frac{1}{2}$ inches.

The curved diameter on the rim, as shown, is known as the throat diameter, to distinguish it from the over-all diameter. Following the extension lines to the left of the view, it is seen that the throat diameter is 5.4114 inches. The dimension line placed just over the rim with its arrow point touching the throat curve is drawn from the point where the short center line crosses the center line of the wheel rim. This dimension line indicates that the workman should machine the curved part, or throat, of the rim with a cutting tool having its cutting end formed to an arc of a circle of 1.0443 inches radius. The remaining radius dimension line has its arrow point resting on the curved working line which represents the inner surface of the wheel rim.

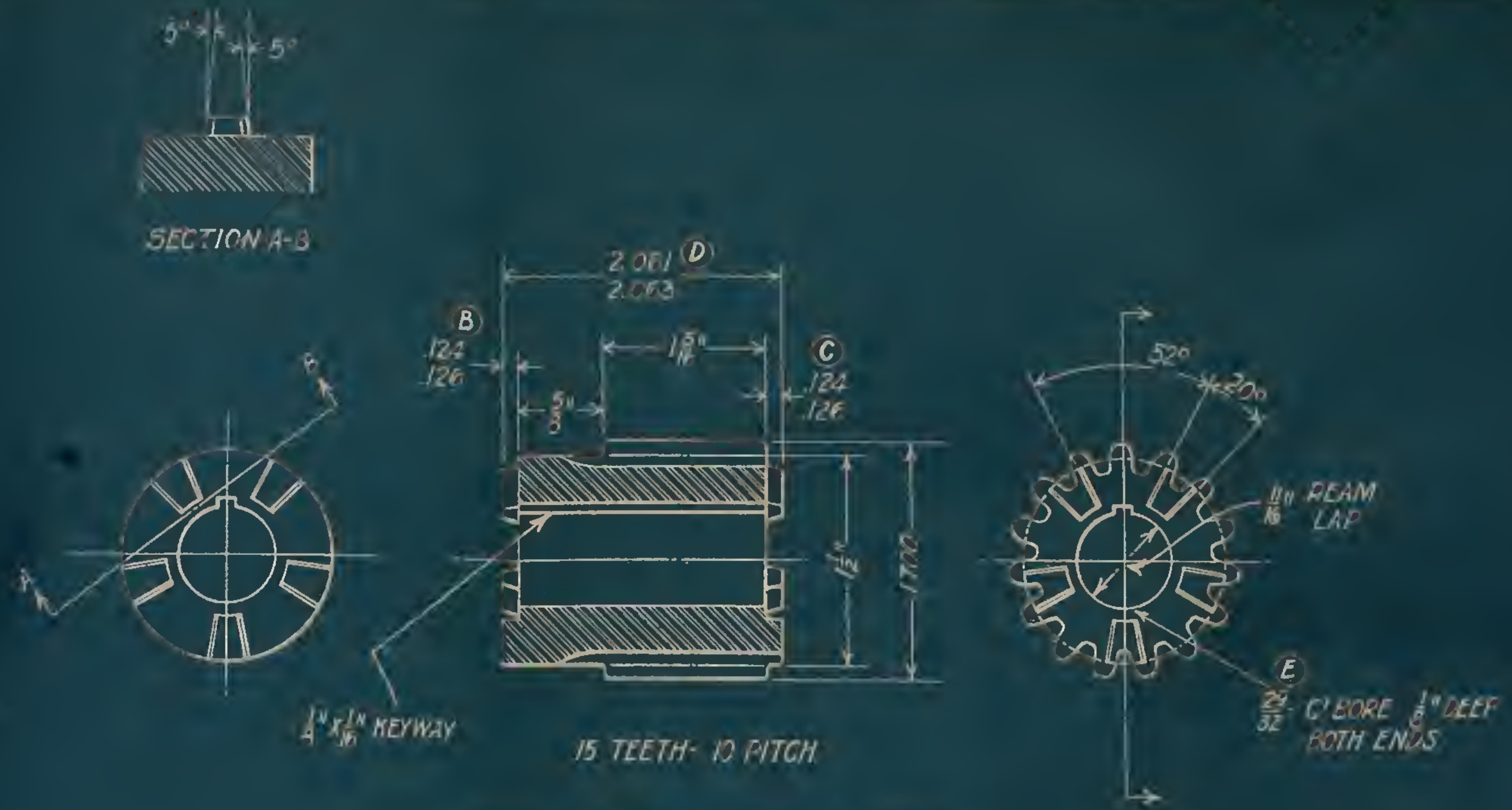
The teeth in worm wheel rims are invariably cut or machined by the use of a special tool known in shops as a *hob,* or a *hobbing cutter.* In using a hob to cut the gear teeth, the workman has to know to what depth the cutting teeth are to be sunk into the rim of the wheel. The sketch in the upper right-hand corner of Plate III indicates in outline the teeth, or threads, on the worm and on the hobbing cutter. This sketch shows: (a) the angle of the sides of the threads; (b) the center-to-center distance, $\frac{1}{2}$ inch; (c) the total depth of the hob thread, 0.3433 inch; and (d) the narrowest width of the hob thread and the space, 0.155 inch. The short note at the right of the view tells us that a keyway is to be cut in the surface of the hub hole $\frac{3}{8}$ inch wide and $\frac{3}{16}$ inch deep.

The *f* marks placed on the working lines of the view show that the sides and the outer surface of the rim and both ends and the hole through the hub are to be finished.

PLATE IV

INTERMEDIATE SHAFT CLUTCH

The piece shown in Plate IV is very nearly the same as that shown in Plate III. The practice is, however, that of another firm and the piece is represented by three views: a front view, a right end view, and a left end view. Reading the lettered data shows the piece to be an intermediate shaft clutch. The cross-section front



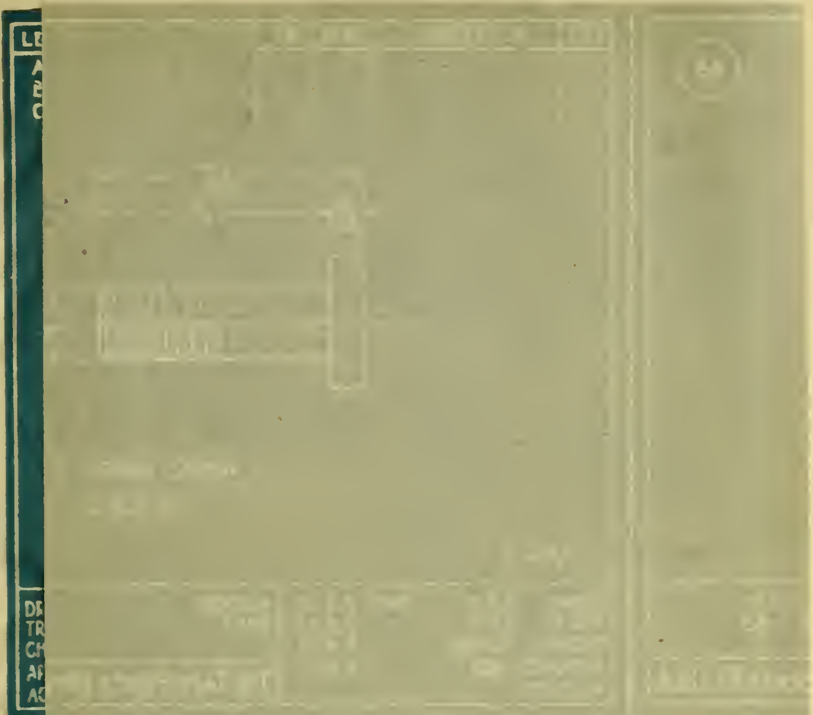
INTERMEDIATE SHAFT CLUTCH

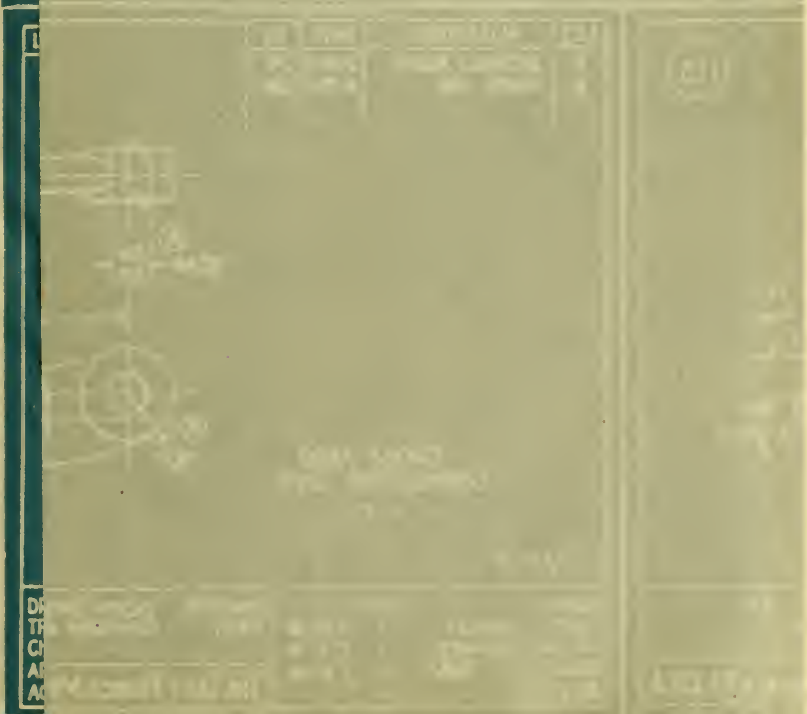
1-CARPENTER #5-317 STEEL
HEAT TO 1475°F. QUENCH IN OIL AND
DRAW TO 550/560°F. TO SHOW 65/75
SHORE SCLEROSCOPE.

LET	ALTERATIONS	DATE	BY
A	REDRAWN	2-16-17	A.H.H.
B	LIMITS ADDED	2-20-17	J.M.I.
C	" "	"	"
D	" "	"	"
E	WAS $\frac{7}{8}$ C'BORE	2-9-18	J.B.A.

IV

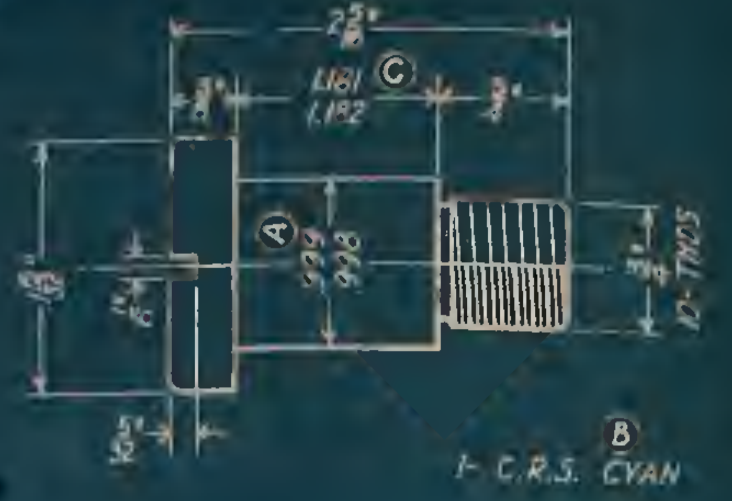
DRAWN A.H.H.	DATE 2-16-17	MACHINE	JOB 2855 R.O.
TRACED A.H.H.	" 2-16-17	PART	PART NUMBER
CHECKED J.B.A.	" 2-16-17		TICKET
APPROVED Rw?	" 2-9-18	THE TAFT-PEIRCE MF'G. COMPANY, WOONSOCKET R.I. U.S.A.	
ACCEPTED	"		





LET	ALTERATIONS	DATE	BY
A	WAS 1.000 & .998	2-21-17	JM
B	CYAN ADDED	" " "	JM
C	LIMITS ADDED	6-25-17	

63



Ⓑ
1- C.R.S. CYAN

V-1

DRAWN　　　　DATE
TRACED　G-E-C　" 11-17-16
CHECKED　ADAMS　" 11-22-16
APPROVED　W.A.　" 11-25-16
ACCEPTED　"

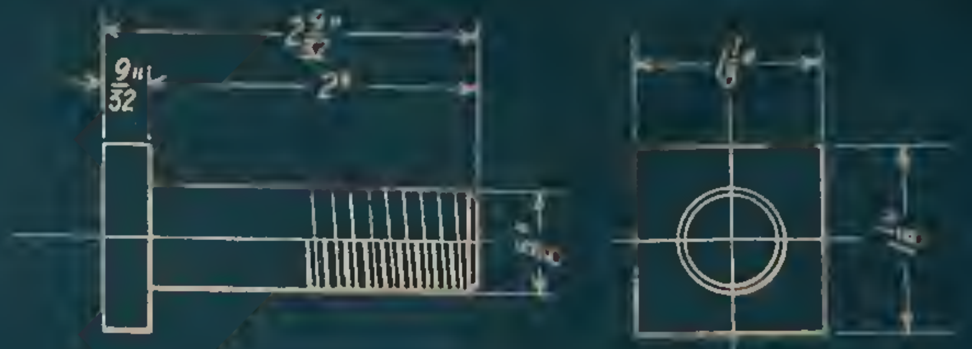
MACHINE SEMI-UNIVERSAL GRIND. MACH.
PART　SWIVEL TABLE STUD

JOB 2855　R.O.
PART NUMBER　63
TICKET

THE TAFT-PEIRCE MF'G. COMPANY. WOONSOCKET, R.I. U.S.A.

LET.	ALTERATIONS	DATE	BY

440



WHEEL GUARD T-BOLT
2- C.R.S.

V-2

DRAWN　H.H.H.　DATE 7-6-17
TRACED　H.H.H.　" 7-6-17
CHECKED　ADAMS　" 7-6-17
APPROVED　W.A.　" 7-10-17
ACCEPTED　"

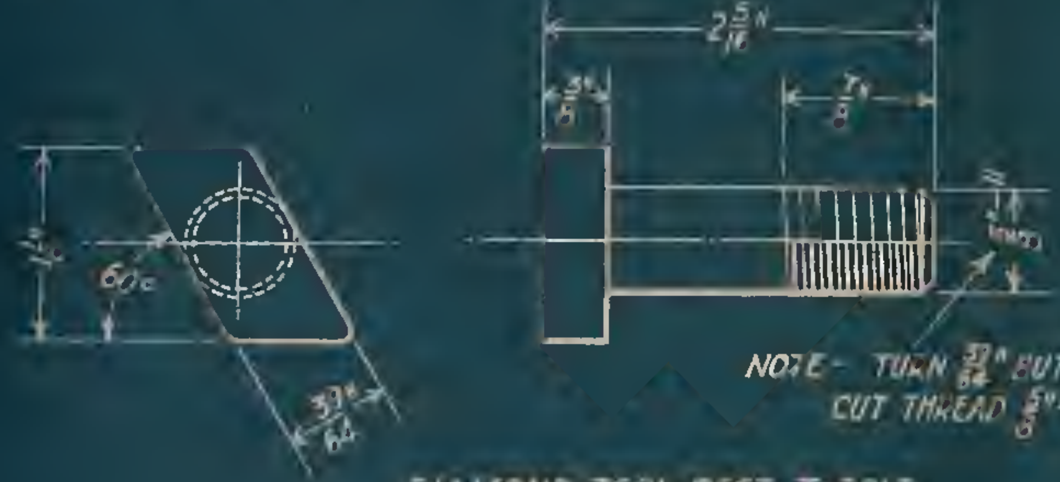
MACHINE
PART

JOB 2855　R.O.
PART NUMBER
TICKET

THE TAFT-PEIRCE MF'G. COMPANY. WOONSOCKET, R.I. U.S.A.

LET	ALTERATIONS	DATE	BY
A	TRACED	4-5-18	E.P.L.

113



NOTE- TURN 39/64" BUT
CUT THREAD 5/8"-11

DIAMOND TOOL POST T-BOLT
1- C.R.S. - CYAN

V-3

DRAWN　　　　DATE
TRACED　E-P-L　" 4-10-18
CHECKED　ADAMS　" 4-15-18
APPROVED　W.A.　" 4-15-18
ACCEPTED　"

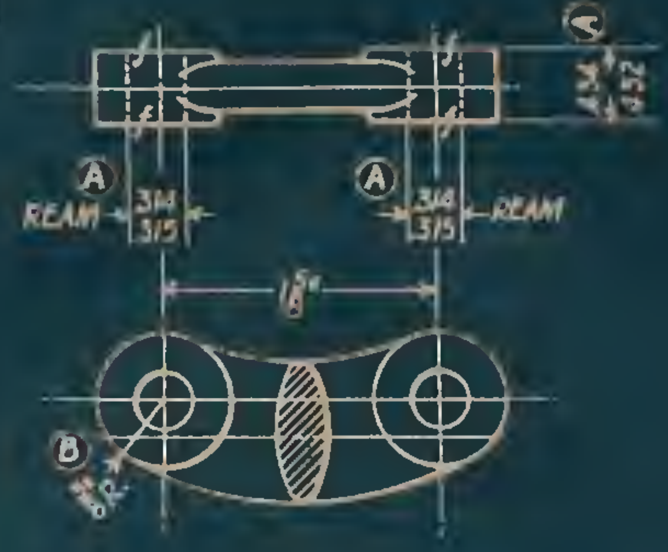
MACHINE
PART

JOB 2855　R.O.
PART NUMBER
TICKET

THE TAFT-PEIRCE MF'G. COMPANY. WOONSOCKET, R.I. U.S.A.

LET	ALTERATIONS	DATE	BY
A	DECIMALS ADDED	2-20-17	JM
B	ADDED DIM.	6-25-17	

345



CROSS FEED
CONNECTING LINK
1- C.I.

V-4

DRAWN　　　　DATE
TRACED　HADLEY　" 5-12-16
CHECKED　ADAMS　" 7-3-16
APPROVED　W.A.　" 7-6-16
ACCEPTED　"

MACHINE　SEMI-UNIVERSAL
PART　GRINDING MACHINE

JOB 2855　R.O.
PART NUMBER　345
TICKET

THE TAFT-PEIRCE MF'G. COMPANY. WOONSOCKET, R.I. U.S.A.

view shows that the material is steel, and a further reading of the lettered note tells us that the company knows this steel as Carpenter No. 5–317 steel. The left end view shows the *general* form of the clutch teeth. A line drawn across this view near a single tooth shows that a section has been sliced off at this point. The line is lettered *A–B* at its opposite ends to enable the workman to find the view of the part sliced off.

Directly above the left end view is a small view named "section *A–B*". This shows a single clutch tooth viewed as if looked at from the inner, or small, end of the tooth. Extension lines projecting upward from the working lines of the tooth show that the tooth sides incline 5 degrees from the vertical. No other view shown tells us this, and therefore it is necessary for the workman to have this small section.

The right end view shows that the clutch teeth are slanted along their sides at an angle of 20 degrees, or, expressed another way, the sides of the clutch teeth make an angle of 20 degrees with each other. From a further study of this view, we learn that the inner surfaces of two adjacent teeth make an angle of 52 degrees. The lettered note at the right and the arrowhead tell us that the inner ends of the clutch teeth are counterbored $\frac{29}{32}$ inch in diameter and $\frac{1}{8}$ inch deep. Just above the front view at each end arrow points have the numerals 0.124–0.126. The decimal fraction for $\frac{1}{8}$ inch is 0.125; the numerals 0.124–0.126 then show that the $\frac{1}{8}$-inch depth must be cut to a tolerance of not more than 0.001 inch above or below the figured depth, $\frac{1}{8}$ inch. The right end view clearly shows that this shaft clutch has gear teeth in its outer surface, and data under the front view states that there are to be fifteen teeth, ten pitch. The only other note for the workman's use is that giving the size of the keyway.

PLATE V

DETAILS OF FOUR MACHINE PIECES

General Data. In the study of Plate V and of all succeeding plates, it will be assumed that the workman has thoroughly studied all that has gone before and understands what is meant by front, top, bottom, and end views, by sections, and by extension and dimension lines, and that he can find and read the dimensions.

Plate V is made up of four blueprints of small details and illustrates the way in which the Taft-Pierce Company send such into their shops. The number placed in the circle located in the upper right-hand corner of each small print is the part number of the piece and will be referred to in this text as the blueprint number. It will be noted that blueprints Nos. 63, 440, and 113 are all blueprints of bolts.

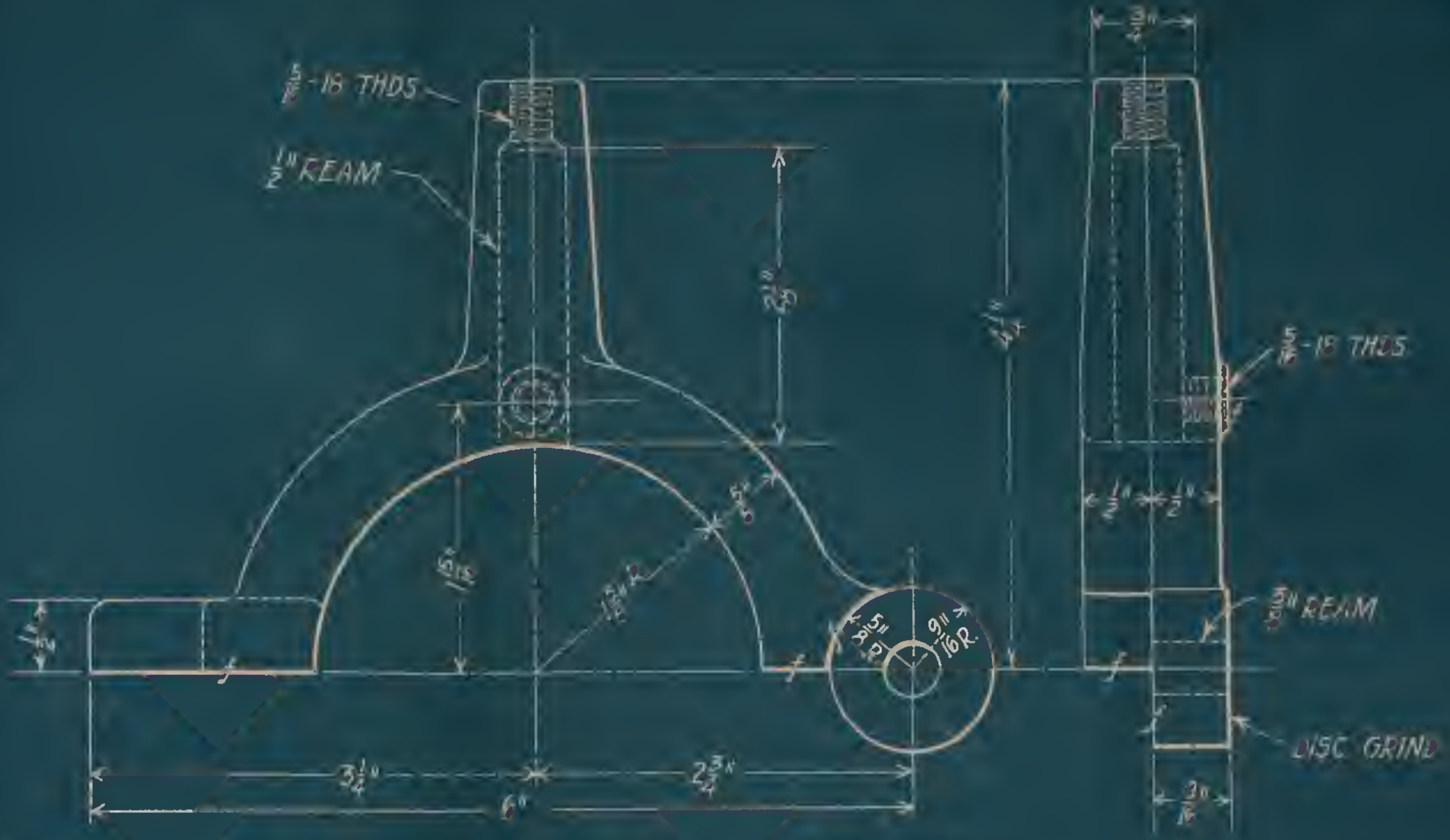
Swivel Table Stud. The piece shown in blueprint No. 63 is a swivel table stud for a semiuniversal grinding machine. A note placed just beneath the view states that the material is cold rolled steel, cyanide hardened. Only one view, a front view, is given, which indicates that the end views would show as circles. From this single view the workman can get all length dimensions and all diameter dimensions. Among the things to be noted in this blueprint are that the right end of the stud is to be threaded ten threads per inch and that some of the dimensions are given in pairs, for example, those of the body of the stud. This means that the length of the body and the diameter of the body, respectively, must lie within the given pair of figures for that dimension. Take the case of the body diameter; it must not be greater than 0.999 inch nor smaller than 0.998 inch, a tolerance of one-half of one-thousandth inch above or below a central dimension.

Wheel Guard T Bolt. Blueprint No. 440 is a wheel guard T bolt, and the note tells us that two are required and that the material is cold rolled steel. A front and a right end view are given. If a single front view of this piece were shown, the workman would infer that the bolt head was a circle; the end view shows that the bolt head is square. A left end view instead of a right end view would indicate this equally well, but in that case the circles which represent the body of the bolt would be dotted circles instead of showing as they do in the right end view. There are no finish *f* marks in either view because the piece, as noted, is made from cold rolled steel bar stock, which has a finished surface, and when the bolt is turned to size, the outer surfaces of the head have the original finish of the bar. Moreover, to construct the rest of the bolt naturally finishes those parts.

Diamond Tool Post T Bolt. Blueprint No. 113 is a diamond tool post T bolt, and the lettered note states that one is required

LET	ALTERATIONS	DATE	BY
A			

630



CENTER REST TOP
1- CAST IRON

LET	ALTERATIONS	DATE	BY
A			

V1

DRAWN Jennings DATE 3-24-17
TRACED "
CHECKED J.B.A. " 4-2-17
APPROVED "
ACCEPTED "

MACHINE
PART

JOB 2855 R.O.
PART NUMBER
TICKET

THE TAFT-PEIRCE MF'G. COMPANY, WOONSOCKET R.I. U.S.A.

and that the material is cold rolled steel, cyanide treated. Two views of this piece are necessary. The views differ from those shown in blueprint No. 440, since the view showing the bolt head is a left end view. Placed in this way, the circles which represent the body part of the bolt show as dotted circles. Another interesting thing is that the body dimension of the bolt is given by the dimension figures as $\frac{5}{8}$ inch, while a lettered note with an arrowhead tells us that the body of the bolt is turned to a diameter of $\frac{39}{64}$ inch and that the threaded part is $\frac{5}{8}$ inch in diameter and has eleven threads per inch. The end view shows that the bolt head inclines at an angle of 60 degrees with the base line.

Cross-Feed Connecting Link. Blueprint No. 345 shows a front view and a top view of a cross-feed connecting link. One only is required and both the lettered note and the arrangement of cross-section lines inform us that the material is cast iron. Where the shape of the cross-section is simple, as shown, it is usual to place it directly on one of the views rather than make an additional view. The cross-sections of pulley arms, connecting rods, and links are generally shown by this method. The workman in reading this blueprint should note that the reamed holes have limiting dimensions given and also that the thickness of the hubs is held to a small tolerance. The finish *f* marks clearly show what surfaces are to be machined.

PLATE VI

CENTER REST TOP

The lettered data states that Plate VI is a blueprint of a center rest top. One is required and the material is cast iron. A short study will show the machinist that many of the dimensions are given to or from horizontal or vertical center lines; also that some of the dimensions are plain distances, in which case the dimension line has an arrow point at each end, while others are from a center point and give the radius from that point of the working line which represents the surface. When a radius dimension is given, it is usual to place the initial letter *R.* or the letters *Rad.* after the dimension figures.

In the front view, the workman should especially note that the hole through the length of the upper part of the piece is to be drilled and reamed a part of the way and drilled and tapped eighteen threads per inch for the rest of its length. Another important item is that, while the radius of the hub is given as $\frac{9}{16}$ inch, the frame back of the hub is machined back to a radius of $\frac{5}{8}$ inch.

In the right end view, the things which the machinist should especially note are that one end of the lower hub is marked *f*, while the opposite end is marked "disc grind", indicating that the *f* end is to be carefully finished to an accurate bearing, while it is not necessary to be so particular with the opposite end. The end view also shows that the hole in the hub is to be drilled and reamed. The hole just above the hub is to be drilled and tapped for a $\frac{5}{16}$-inch screw, eighteen threads per inch.

PLATE VII

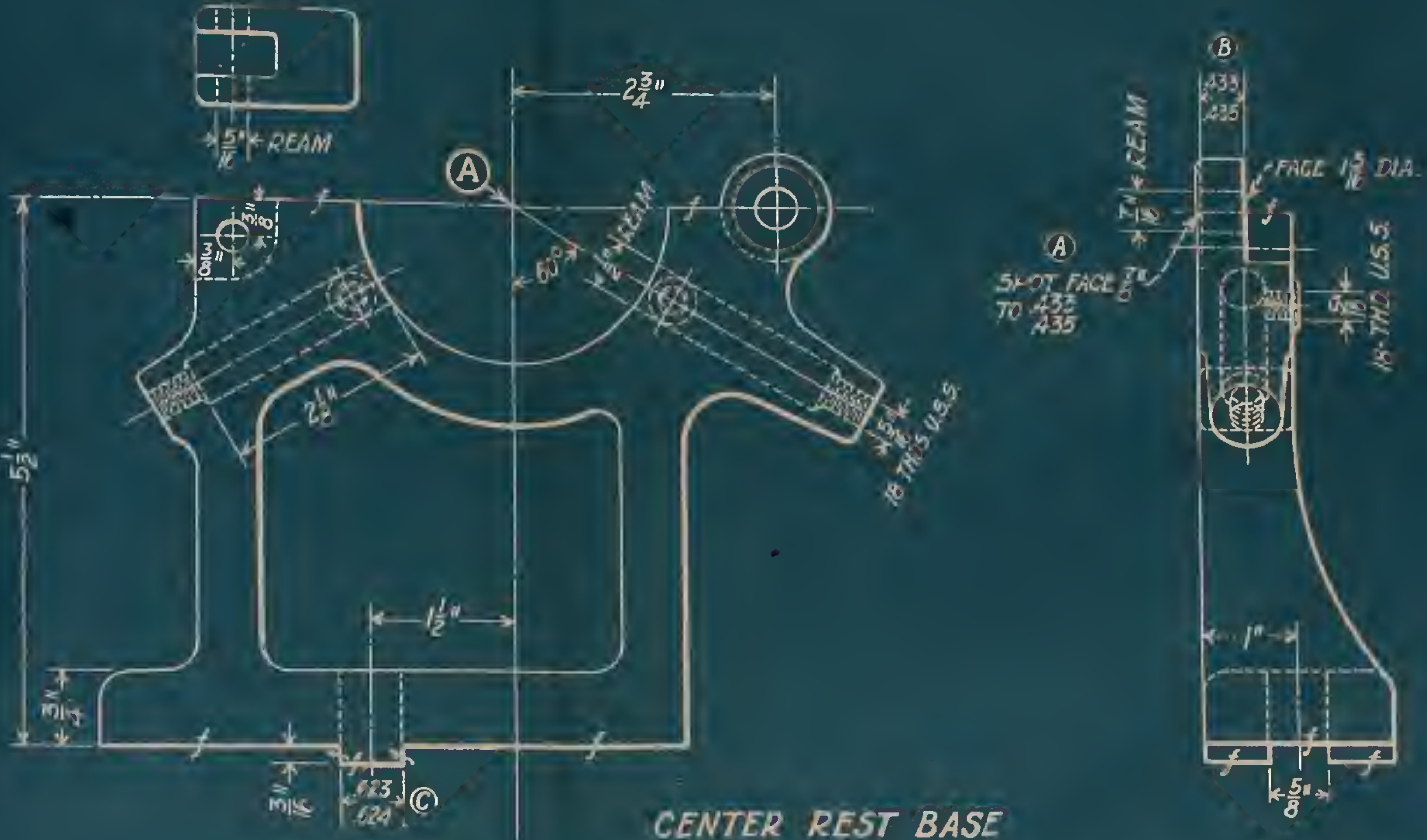
CENTER REST BASE

A reader of this text who is familiar with machine work knows that a center rest is a fixture used in turning or grinding to give support and steadiness to long or slender work. Plate VIII gives a complete view of a center rest and indicates its use and, before taking up a study of Plate VII, it will be well to glance at Plate VIII.

The lettered title of Plate VII states that it is the blueprint of the center rest base. One is required and it is made of cast iron. The piece of work shown is then the mate of that shown in Plate VI and some of its features and dimensions are the same. A complete front view and a complete right end view are given as well as a portion of a top view, which is placed directly above the left upper corner of the front view.

The working lines of the bottom of the front view and the end view show that the base is provided with a squared projection used to locate the center rest on the bed of the machine. Aside from this, the machinist should notice the data which relates to finishing the small hub at the top of the end view and at the upper right corner of the front view. The term "spot face $\frac{7}{8}''$" indicates that the surface touched by the arrow point is to be finished, by using a counterbore $\frac{7}{8}$ inch in diameter, to the limiting thickness given just above the end view. It should be noted that

LET.
ALTERATIONS
DATE
BY



CENTER REST BASE

1- C.I.

DRAWN	G.R.	DATE	4-24-17
TRACED		"	
CHECKED	ADAMS	"	4-27-17
APPROVED	MAJ	"	4-27-17
ACCEPTED		"	

MACHINE
TOOL
PART

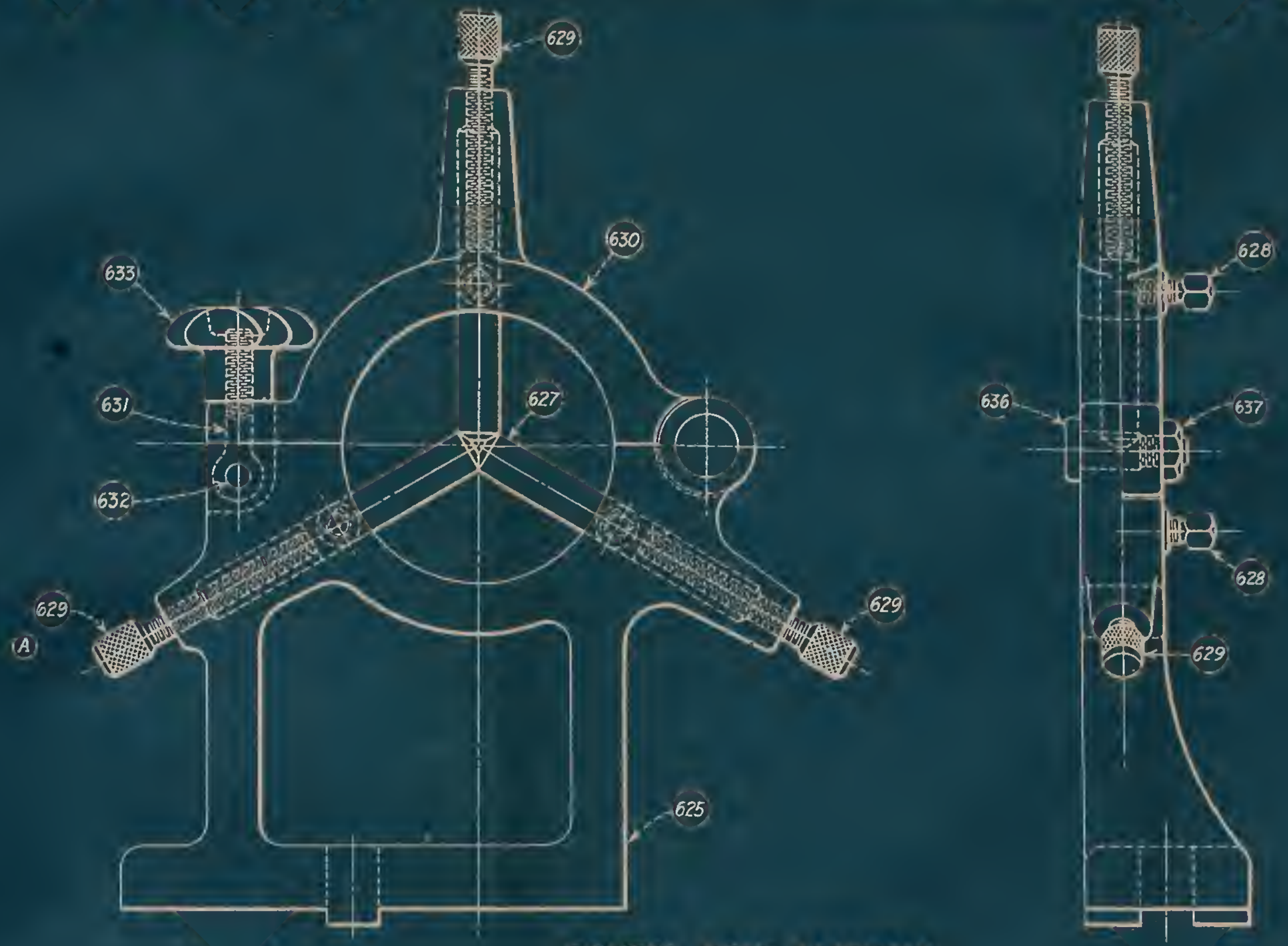
JOB 2855 R.O.
TOOL NUMBER
TICKET

THE TAFT-PIERCE MFG. COMPANY. WOONSOCKET. R.I. U.S.A.

LET.	ALTERATIONS	DATE	BY
Ⓐ	NOTE ADDED		
Ⓑ	DIM. CHANGE		
Ⓒ	LIMIT ADDED	2-26-17	JM

VII

626



CENTER REST ASSEMBLY

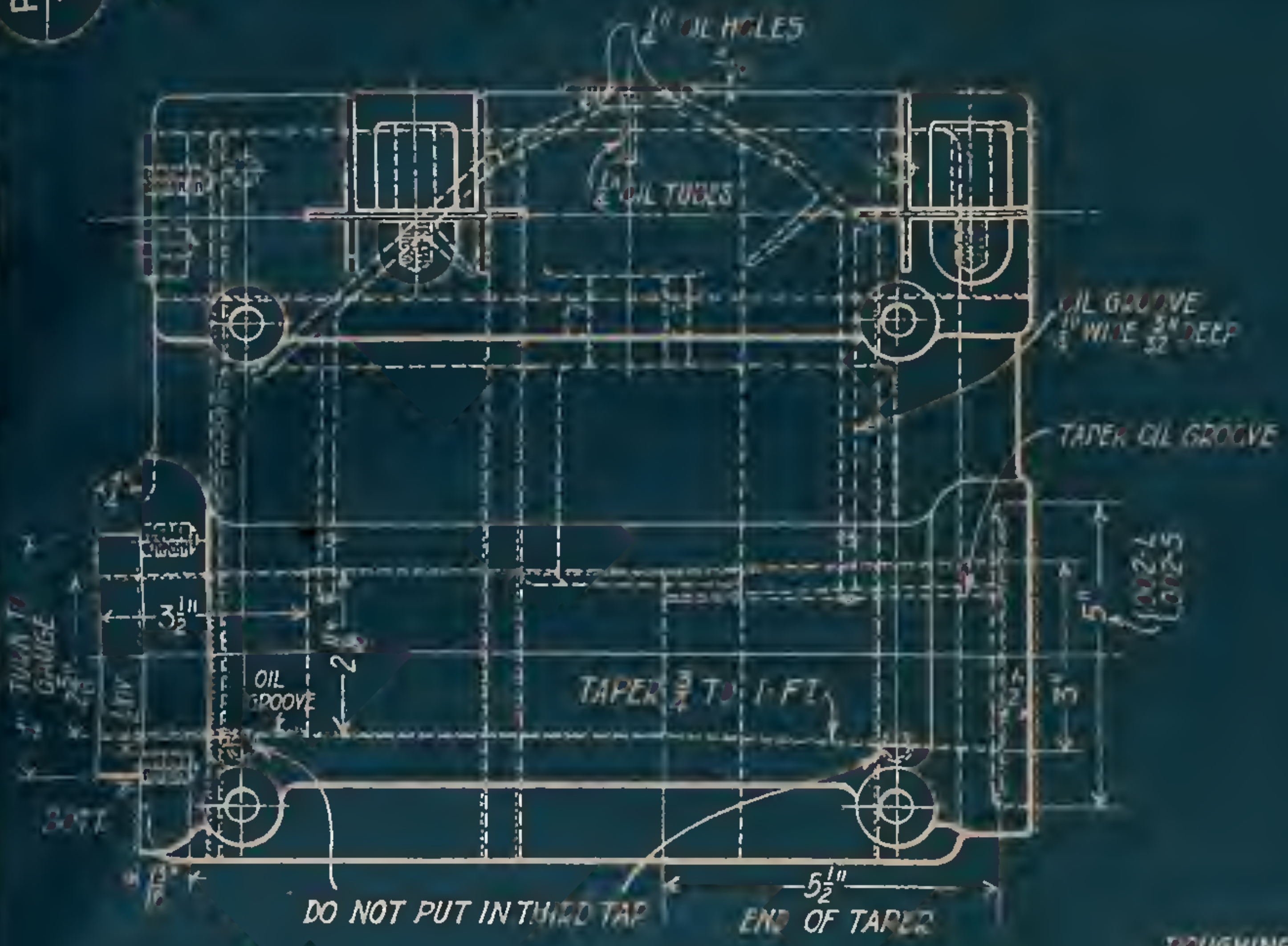
LET	ALTERATIONS	DATE	BY
A	RENEW P.T. 629	4-2-18	G.A.

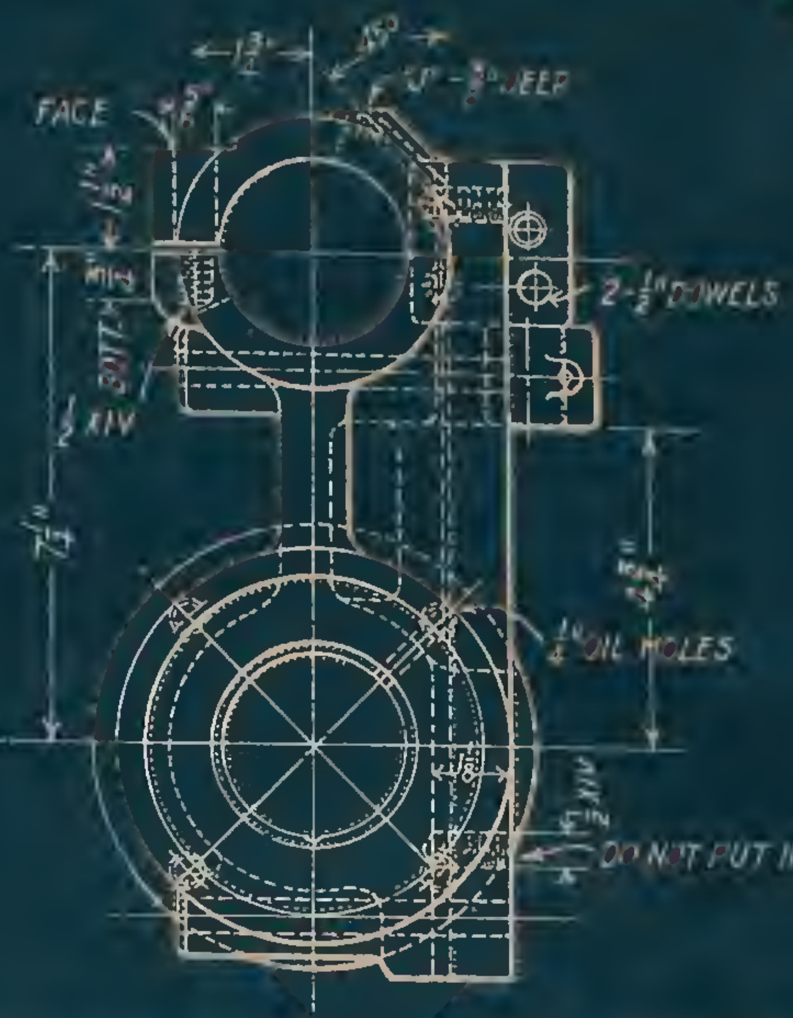
VIII

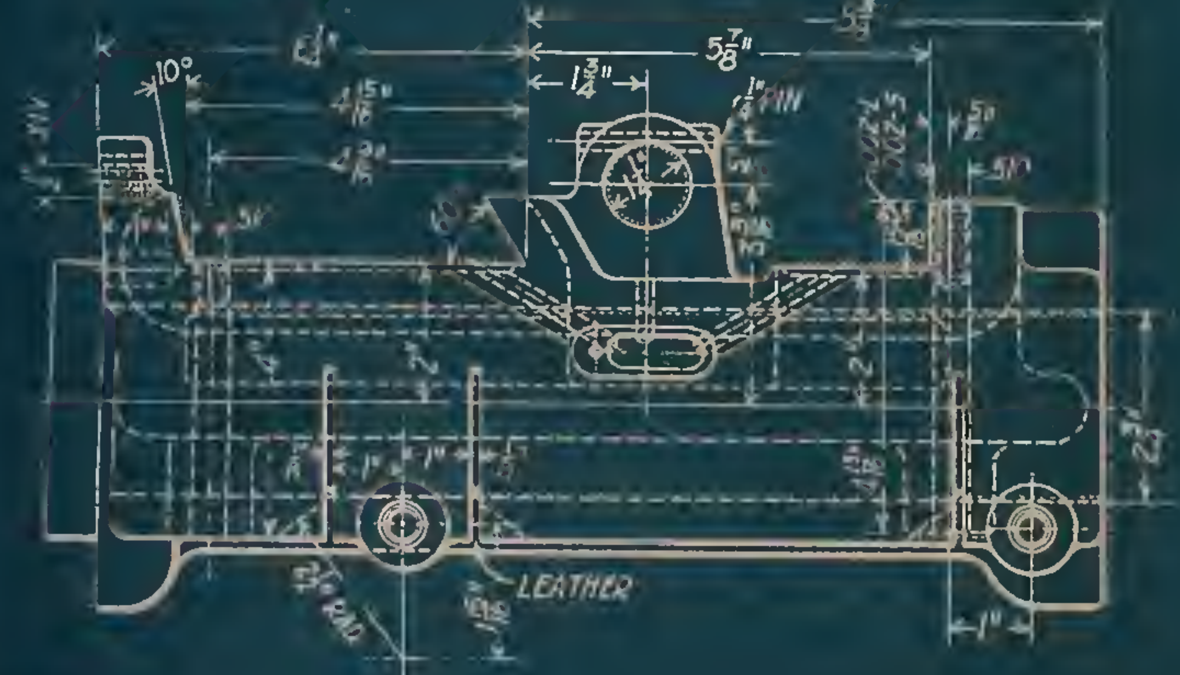
DRAWN		DATE		MACHINE	JOB 2655 R.C.
TRACED	A.H.H.	"	4-24-17	TOOL	TOOL NUMBER
CHECKED	ADAMS	"	4-27-17	PART	TICKET
APPROVED	Mad	"	4-27-17	THE TAFT-PIERCE MFG. COMPANY. WOONSOCKET, R.I. U.S.A.	
ACCEPTED		"			

P13
16

2A-3258







ROUGHING CUTTERS FOR WAYS
PLUG GAUGES FOR STRAIGHT BEARING
PLUG GAUGES FOR WORK SPINDLE HOLE
SHELL REAMER FOR WORK SPINDLE HOLE
JIG FOR ELEV. SCR. NUT HOLE
TEST BAR FOR SCRAPING
DRILLS & REAMERS
JIG FOR DRILLING
FORM TOOL FOR REAMER
GAUGE FOR WAYS
FIXTURE FOR ROUGH MILLING
FIXTURE FOR FINISH MILLING
CLAMPS

WORK SPINDLE SLIDE

1-C.I. $\frac{P13}{133}$

SCALE 1/2 SIZE

TIME	P 13	LOT

NO. 13 AUTO. GEAR CUTT. M'CH.

WORK SPINDLE SLIDE

DATE OCT. 29 1915 Syd Bennett EX. A.B.C.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R.I.

P13
16

IX

certain of the holes are drilled and reamed while others are drilled and threaded with a tap. The machinist should carefully observe on which of the working lines of the views the *f* mark is placed. He should also note in Plate VII, as in Plate VI, that many of the dimensions are given to or from horizontal or vertical center lines and that all dimensions bear a certain relation to a common center, or axis, *A*. In reading the dimension figures, the machinist will find that several of them have a limiting error tolerance telling him that he must be especially accurate in those dimensions.

PLATE VIII

CENTER REST ASSEMBLY

Plate VIII shows two views, and the lettered title placed just below the views states that the piece is a center rest assembly. The two views furnish a line picture of the completed center rest and show all its separate parts as they are when *assembled* or, as it is often termed, *set up*. It will be noted that each and every part is given a number. These numbers are known as the piece, or part, numbers.

PLATE IX

WORK SPINDLE SLIDE

Compared with many of the blueprints shown, Plate IX, showing the work spindle slide, is difficult to read and it has been selected to illustrate a fairly complicated and irregularly shaped piece. As an aid in reading this blueprint, a short study should be made of the general form and shape of the piece as shown in outline in the front, right end, and top views. An examination of the views shows that the piece consists in general of two hubs, or cylinders, with holes through their length. The cylinders are placed with the smaller above the larger and are connected by a short web running their entire length. When the reader clearly sees this and has the picture clearly in his mind, he can then study the various small hubs, bosses, and other pieces attached to the two long hubs and their connecting flange.

In tracing the location and shape of the several parts, holes, etc., it should be kept clearly in mind that each part in the front view, if shown in the top or in the end view, will be squarely above or squarely to the right of its position in the front view.

Another thing which aids the reader in getting a picture of the piece in mind is its name, "work spindle slide." The note just over the name plate, "Scale Half Size," of course applies to the original blueprint only and not to the reproduction in this text.

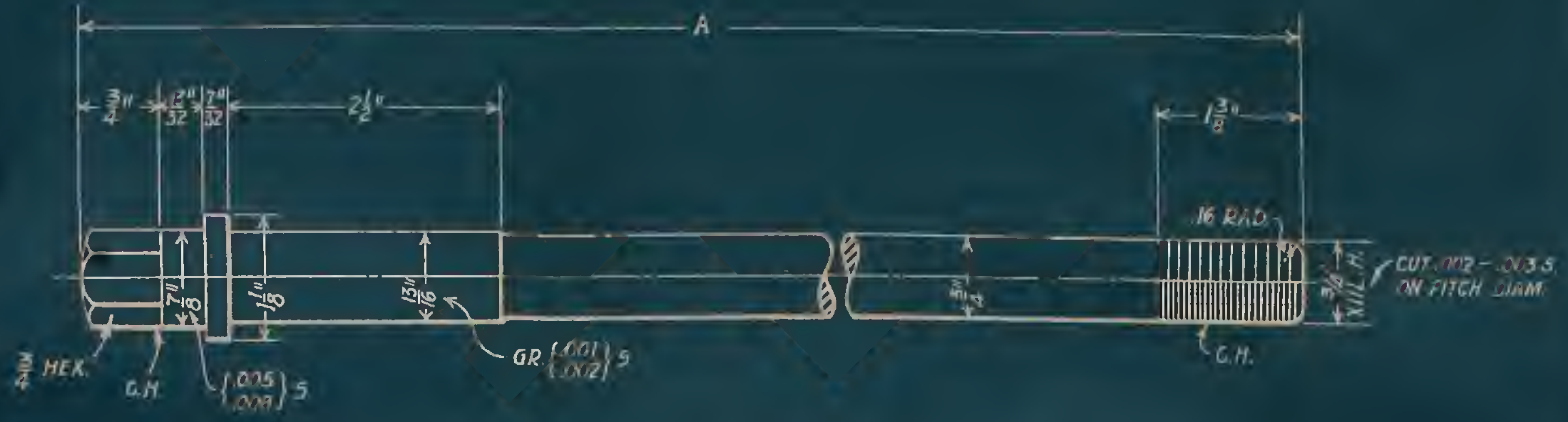
Several helps in the form of lettered notes are on this blueprint. As an example, attention is called to a note at one end of the front view which tells us that the dotted lines on which the arrow points touch represent oil grooves $\frac{1}{4}$ inch wide and $\frac{3}{32}$ inch deep. From a study of the upper part of the front view and of the end view we learn at which points the oil grooves start and also that they are drilled at an angle of 45 degrees to reach the surfaces of the slide bearings.

Among the specially important things to be noted is that, while the hole through the length of the smaller of the two long hubs is a straight plain cylindrical hole, the hole through the larger is tapered at its right-hand end $\frac{3}{4}$ inch to the foot for a distance of $5\frac{1}{2}$ inches. Attention is also called to the two slide bearings on the rear side of the work, one slide bearing having right-angle sides and the other a 60-degree side. Threads per inch on blueprints at the shops of the Brown & Sharpe Manufacturing Company are invariably given by Roman numerals. For example, as may be noted on the blueprint, a hole threaded fourteen threads per inch is marked *XIV*. Also, each surface which is to be finished is indicated by drawing a brilliant red line close beside the working line which represents the surface. On this plate and on Plates XII and XIII these lines are shown dotted and are drawn close to the finished surface lines. Lettered notes placed on this blueprint state what special tools should be got from the tool room before starting the work.

PLATE X

DRAWING-IN BOLT

Plate X shows a drawing-in bolt, and the lettered note just below the name tells us that one is required, that the material is cold rolled steel, that it is a forging, that it is forged on a heading machine, and that it is to be casehardened as shown. The fact that the forging is done on a heading machine indicates that the head end only is upset to its rough shape. The letters *C.H.*



DRAWING IN BOLT

1- C.R.S. A2278 A, B, C, FORGING.
CASE HARDEN AS SHOWN.
FORGED ON HEADING MACHINE.

STOCK

A 2278 A	DIA.	LONG
A 2278 B	DIA.	LONG
A 2278 C	DIA.	LONG

SYMBOL A 2278 A A= $25\frac{7}{8}$''
USED ON C2

SYMBOL A 2278 B A= $29\frac{15}{16}$''
USED ON C3

SYMBOL A 2278 C A=
USED ON C5

TIME	A 2278	LOT	

C2, C3, C5,

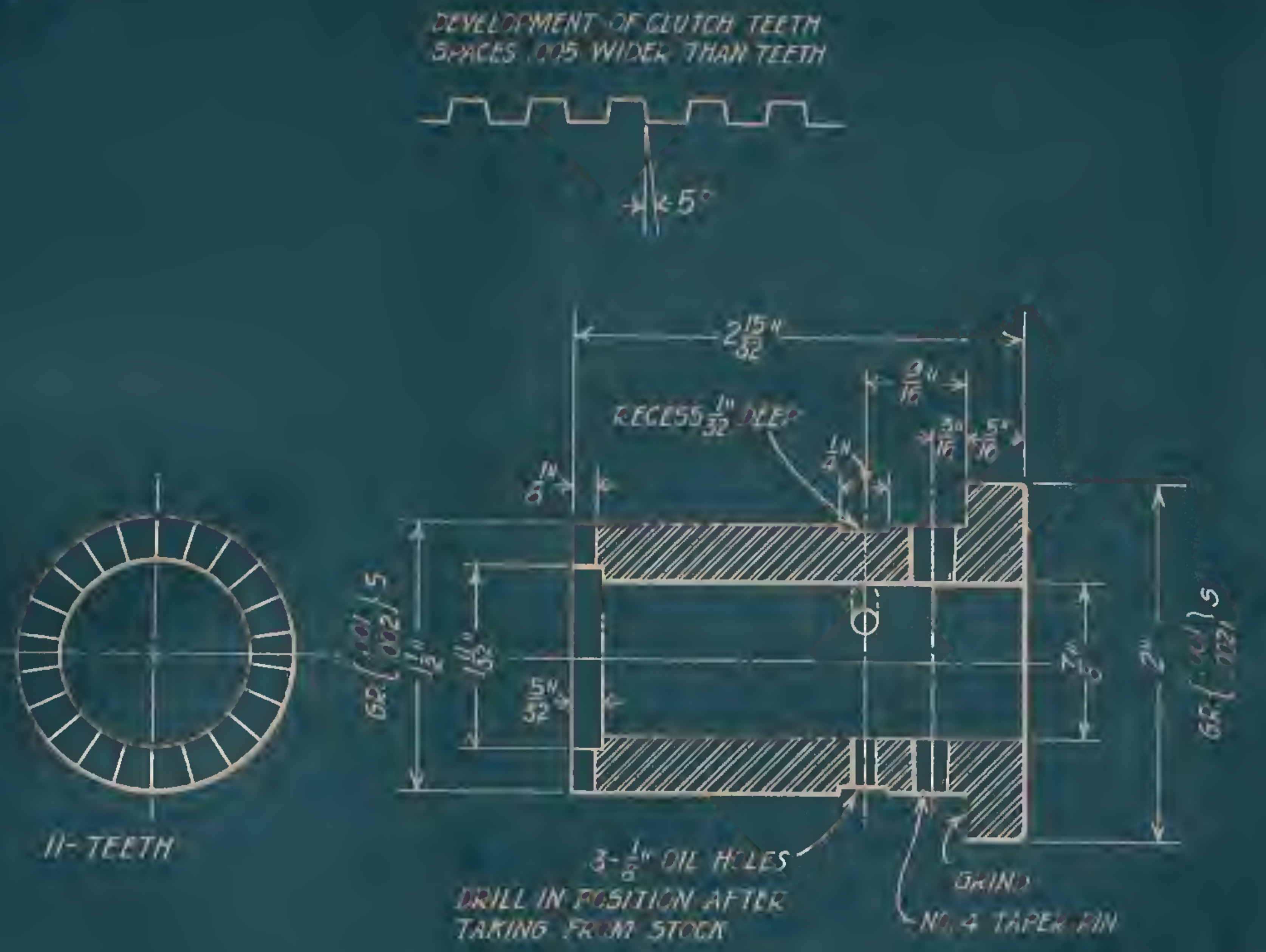
DRAWING IN BOLT

DATE APRIL 23 1917. A.P.L. EX. R.S.L.

BROWN & SHARPE MFG. CO.,
PROVIDENCE, R.I.

A2278 B.P.G.

X


DEVELOPMENT OF CLUTCH TEETH
SPACES .005 WIDER THAN TEETH

11-TEETH

RECESS 1/32" DEEP

3-1/8" OIL HOLES
DRILL IN POSITION AFTER
TAKING FROM STOCK

GRIND

NO. 4 TAPER PIN

KNEE SHAFT CLUTCH
M.S.
FORMED TOOL # 9846

STOCK :-
2 1/16" DIAM. x 2 9/16" LONG

X1

TIME	A2227	LOT	

A3, AA3, BBH2, B3, BB3, C2

KNEE SHAFT CLUTCH

DATE DEC. 28 1916 J.H.G. EX. A.H.C.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R.I.

A2227	B.P.G.	W.R.P.

placed just below the threaded end and just below the $\frac{3}{4}$-inch hexagon end show that the bolt is to be casehardened at these places, according to the lettered notes. One view only is given, which indicates that an end view would show circles unless otherwise specified. A note at the extreme left end of the view states that the end is made a $\frac{3}{4}$-inch hexagon.

All length dimensions are easily read with one exception, that of the over-all length, which is represented by the capital letter *A*. Notes lettered on the blueprint at the lower right-hand corner inform us that, when this bolt is made for and used on C2, *A* is $25\frac{7}{8}$ inches in length, and when it is made for and used on C3, *A* is $29\frac{15}{16}$ inches. While all the diameter dimensions are easily read, the machinist should surely note that several of them have lettered notes giving additional information. For example, we read that the $\frac{13}{16}$-inch diameter is to be ground 0.001 or 0.002 inch small, "Gr. $\left\{\begin{matrix}.001\\.002\end{matrix}\right\}$S." In this blueprint, the letters *Rad.* are used instead of the capital letter *R.* to denote a radius.

PLATE XI

KNEE SHAFT CLUTCH

The title plate at the lower right of Plate XI tells us that the piece of work shown is a knee shaft clutch. Further information given on the title plate indicates that this clutch is used on A3, AA3, BBH2, etc. A lettered note placed on the blueprint just below the two views states that the knee shaft clutch is to be made of machinery steel, that the rough stock is a piece measuring $2\frac{1}{16}''\times2\frac{9}{16}''$, and that a certain formed tool is used by the machinist. All the length and all the diameter dimensions are easily found and read, while a copious use of notes gives the machinist much special information. For example, a lettered note placed just below the front view tells us that a certain hole is drilled in position after the piece is taken from stock. This indicates that when finished by the machinist to be placed in stock, this hole is left off and that when the setting-up man gets the piece from the stockroom, he places it in position and then drills it in place. Before starting work on this piece, the machinist should read all notes. The front view is a complete section.

In this blueprint, the information concerning the clutch teeth is contained in a small view placed somewhat above the front view and named a "development of clutch teeth." This view represents the outer surface of the clutch teeth rolled out on a flat surface, as explained in "Mechanical Drawing," Part III, page 107. The note tells us that the spaces between the teeth are 0.005 inch wider than the teeth. The view also shows that the sides of the teeth slant to an angle of 5 degrees. The end view is sufficiently complete to show the form of the clutch teeth only, a lettered note placed just below the view giving the number of clutch teeth as eleven. As both views show that the piece of work is by construction finished all over inside and out, no finish needs to be indicated.

PLATE XII

BACK TOOL POST

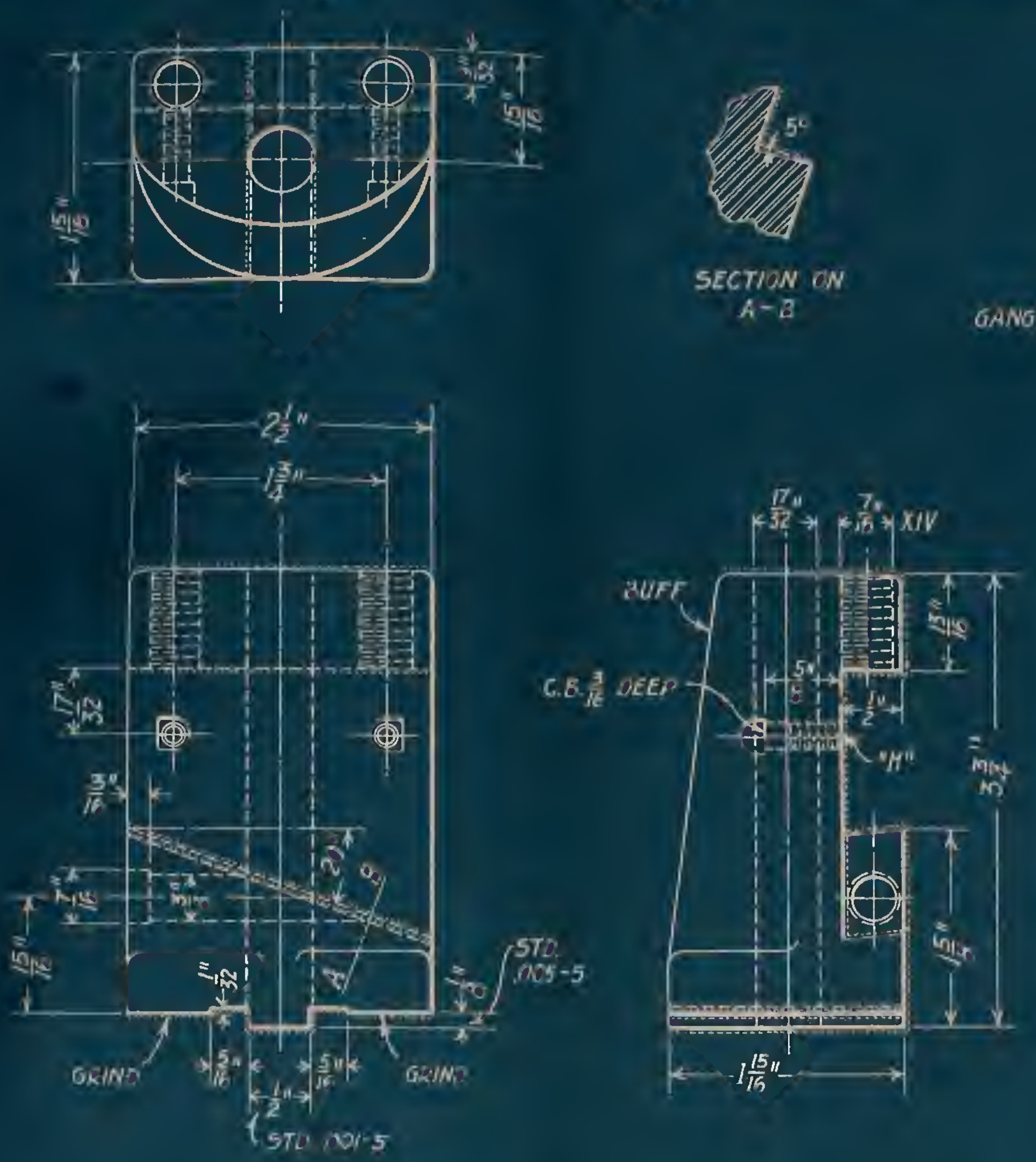
The title plate informs us that the piece shown in Plate XII is the back tool post and that there are a set of tool posts. A lettered note placed at the upper right tells us that the tool post material is M.I. and that it is to be casehardened to have a mottled surface. This plate, like Plate IX, lists up the special tool-room tools for the job. The views given are front, top, and end views supplemented by a small section view, placed just above the right end view, showing a section on line *A–B*.

This small *A–B* section shows that the bottom of the large slot running through the tool post is at an angle of 5 degrees with the back surface of the slot. The working lines of this slot, as shown in the front and the end views, indicate that the top surface of the slot is parallel to the top surface of the tool post and that the lower, or bottom, surface of the slot makes an angle of 20 degrees with a center line drawn parallel to the upper surface of the slot. Working lines, drawn as full lines in the front and the end views but dotted in the top view, show a projecting feather on the under side of the tool post base. Clearly defined dimension lines and figures give the width, depth, and length of the piece. The machinist should note that the width is to be made standard 0.001 inch small; also that certain base surfaces are to be surface ground.

[illegible]

[illegible]

FG2
3



TOOL POST (BACK)

1-M.I.-C.H. MOTTLED $\frac{FG2}{2}$

JIGS FOR DRILLING # 11944 & 11944-2
FIXTURE FOR MILLING WEDGE SLOT # 11943 & 11943-1
FIXTURE FOR MILLING BOTTOM # 11959
GANG OF 3 CUTTERS FOR MILLING SLOT # 9177-# 9178-# 9180
ANGULAR CUTTERS # 11937
CUTTERS # 11942

SPECIAL VISE FOR 20° { # 11980
11980-1
# 11980-4

SYMBOL FG2-B

TIME | FG2 | LOT

SET OF TOOL POSTS

TOOL POST (BACK)

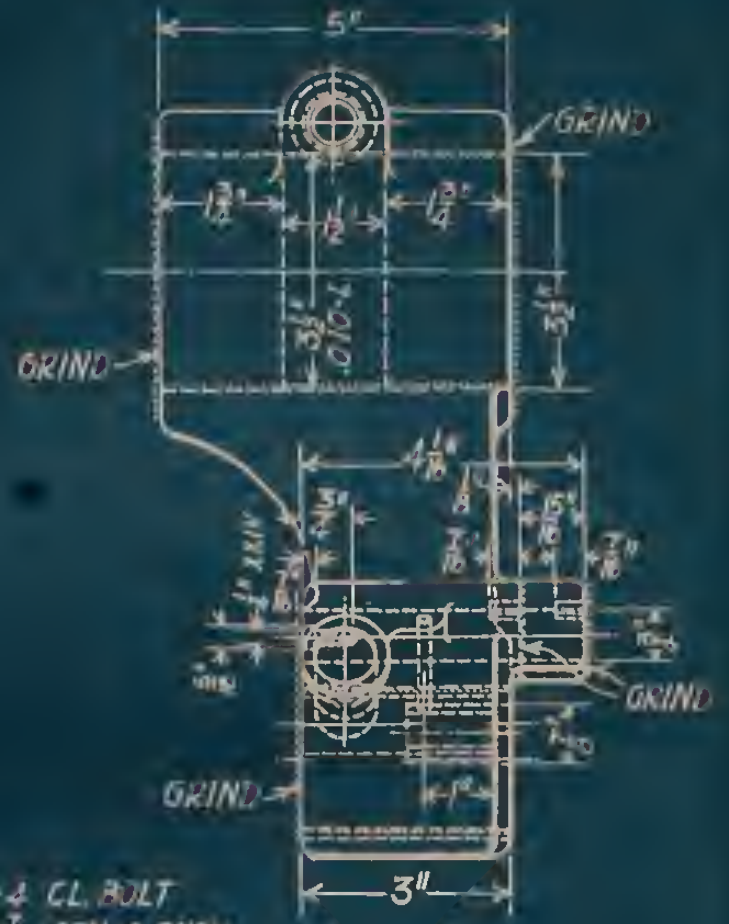
DATE APRIL 19 1916 J.P.R. EX. ~~2.20~~

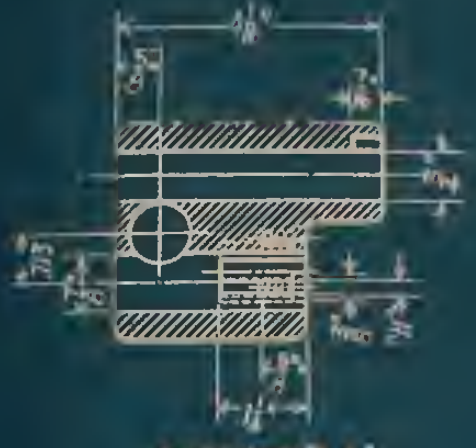
BROWN & SHARPE MFG. CO.,
PROVIDENCE, R.I.

FG2
3

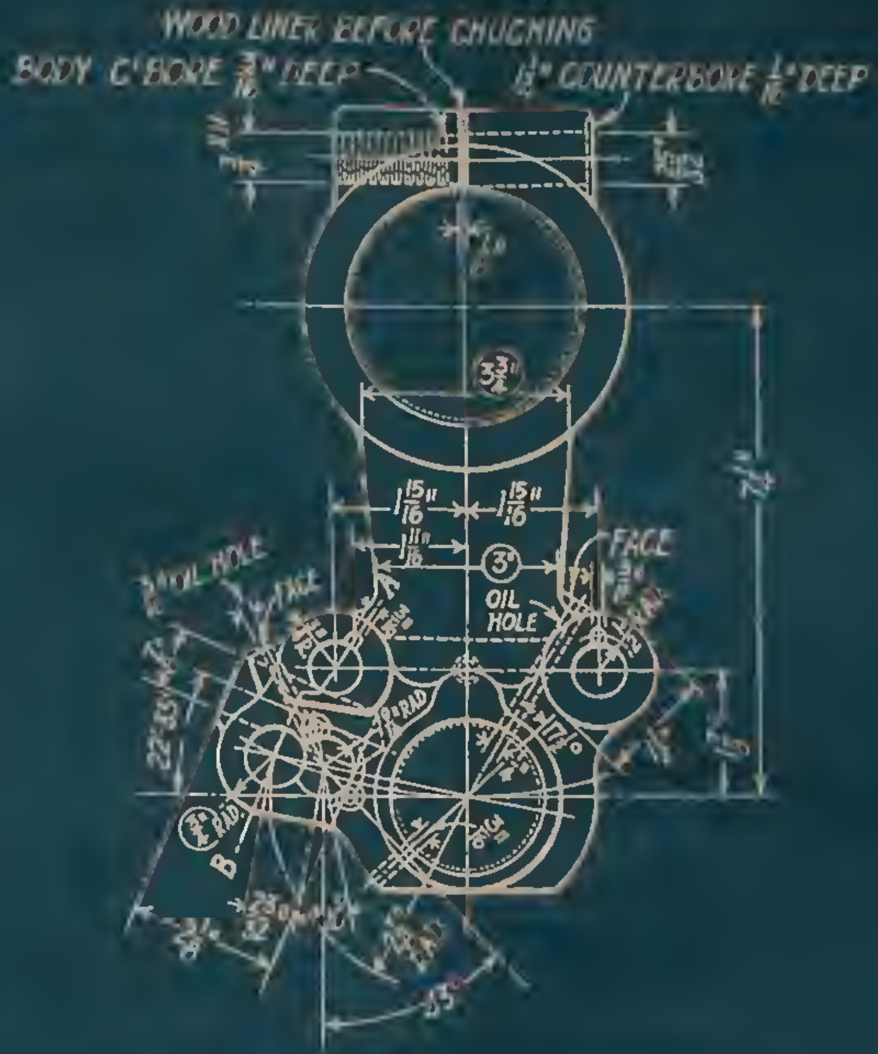
FG2

XII





SECTION "A-B"


WOOD LINER BEFORE CHUCKING
BODY C'BORE $\frac{3}{16}$" DEEP
$1\frac{1}{2}$" COUNTERBORE $\frac{1}{16}$" DEEP
$3\frac{3}{4}$"
$1\frac{15}{16}$"
$1\frac{15}{16}$"
FACE
FACE
OIL HOLE
OIL HOLE
A
B
$7\frac{1}{4}$"
53°

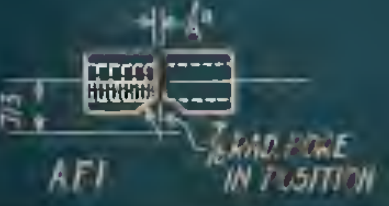
CENTRE ARM HEAD
C.I. A2313
MADE ON MOULDING MACHINE

FURNISH :-
1- STY. 3 A=$\frac{3}{4}$ B=4 CL. BOLT
2- STY. 20 A=$\frac{11}{16}$" B=$\frac{7}{16}$ CEN. A. BUSH.
1- STY. 27 A=$\frac{1}{2}$ B=$\frac{1}{2}$ CL. PLATE
1- STY. 56 A=$\frac{3}{4}$
1- STY. 56 A=$\frac{1}{2}$
1- STY. 89 B=$\frac{1}{4}$ #2- ADJ. WORM
2- STY. 90 A=$\frac{3}{4}$ B=$\frac{3}{4}$ ARM S.CL. BOLT
1- STY. 90 A=$\frac{3}{4}$ B=$\frac{1}{2}$ CEN. ARM HEAD
2- STY. 101 A=$\frac{1}{2}$ B=$\frac{3}{16}$ ARM S. CL. BOLT
2- STY. 204 A=$\frac{1}{2}$ B=$\frac{3}{8}$ D=$1\frac{3}{8}$ ARM CL. BOLT
1- STY. 204 A=$\frac{5}{8}$ B=$\frac{1}{2}$ D=$1\frac{1}{4}$ CLAMP BOLT
1- CENTRE A52
1- CENTRE ADJUSTING WORM A53
1- CENTRE ADJUSTING WORM BUSHING A193- COUNTERBORE FOR SCREWS
1- CENTRE ADJUSTING WORM HEAD A194-DRILL FOR #2 TAPER PIN- C.H.
1- ARM SUPPORT CLAMP BOLT (LONG) A1338-A
1- ARM SUPPORT CLAMP BOLT (SHORT) A1338-B
1- CENTRE ARM HEAD CLAMPING PLATE A2351
1- CENTRE ARM BUSHING B52-A
1- CENTRE CLAMP BOLT $\frac{S.F.15}{10}$
1- CLAMP PLATE SPRING WASHER $\frac{S.F.201}{26}$
1- CENTRE CLAMP NUT BUSHING $\frac{S.P.115}{6}$ SEE SKETCH

FIXTURE FOR CHUCKING # 12247
FIXTURE FOR FACING HUBS # 12248
JIG FOR DRILLING # 12249
TOOLS FOR DRILLING (SEE LIST)
JIG FOR DRILLING ADJ. BUSH. SCR. HOLES # 12250

JIG FOR DRILLING PIN HOLES # 12251
JIG FOR DRILLING PIN HOLE TO LOCATE BUSHING # 12252
CUTTERS FOR MILLING ARM BRACE SEAT # 12253 # 12254
ARBOR FOR SPLITTING # 12235
GAUGE FOR TESTING CENTRE DISTANCE # 12255

SCALE $\frac{1}{2}$ SIZE



TIME A2313 LOT
A$1\frac{1}{2}$, A2, AA2, B$1\frac{1}{2}$, B2, BB2, BY1, BY2, B1,
AA1, AA$1\frac{1}{2}$, BB1, BB$1\frac{1}{2}$

CENTRE ARM HEAD (COMPLETE)
DATE JUNE 18 1917 J.K. EX. A.H.C.
BROWN & SHARPE MFG. CO.
PROVIDENCE, R.I.

A2313 B.P.G. VB

XIII

PLATE XIII

CENTER ARM HEAD

Plate XIII is in some respects similar to Plate IX. In reading this plate, the machinist should first strive to get a general picture of the piece well fixed in his mind. As an aid to this, he will first note that the work, a center arm head, consists of two principal hubs separated by a web or shank to give a center-to-center distance of $7\frac{1}{4}$ inches. The upper hub is simple, having as it does a plain hole through its length and a binder boss on its upper side to be drilled, tapped, and counterbored for a binder bolt. The lower hub, however, is well surrounded by projecting parts which, as they carry several holes and other finished surfaces, decidedly present difficulties to the reader. He will do well to take up each hole as shown in the end view and study each as a single hole, getting its position located in each view.

The larger hole, it will be noted, passes entirely through the main lower hub. The hole placed slightly above this hole and to the right hand of the end view can, by studying the front view, be seen to pass entirely through its hub from end to end. The upper hole of the three shown to the left of the main lower hole will be found to be placed on a center line with the one just noted. A small cross-section view just above, lettered "section *A–B*," aids the reader in clearing up the details of this hole and the two similar lower holes; he should carefully note where the section line *A–B* is drawn on the end view. A study of the front view and of the section view shows that the upper of the three holes passes entirely through the casting from end to end. A study of the two lower holes in the end view shows that they break into each other. Their location in the front view and in the small section view indicates that, while the hole farthest to the left passes entirely through the casting, the other, which cuts into it, is only $1\frac{1}{4}$ inches deep. Extensions of the centers of these two holes show by dimension figures that their center-to-center distance is $\frac{23}{32}$ inch, and a radius line just below the end view shows that the center of the outer hole is $2\frac{7}{8}$-inch radius from the center of the hole in the main lower hub.

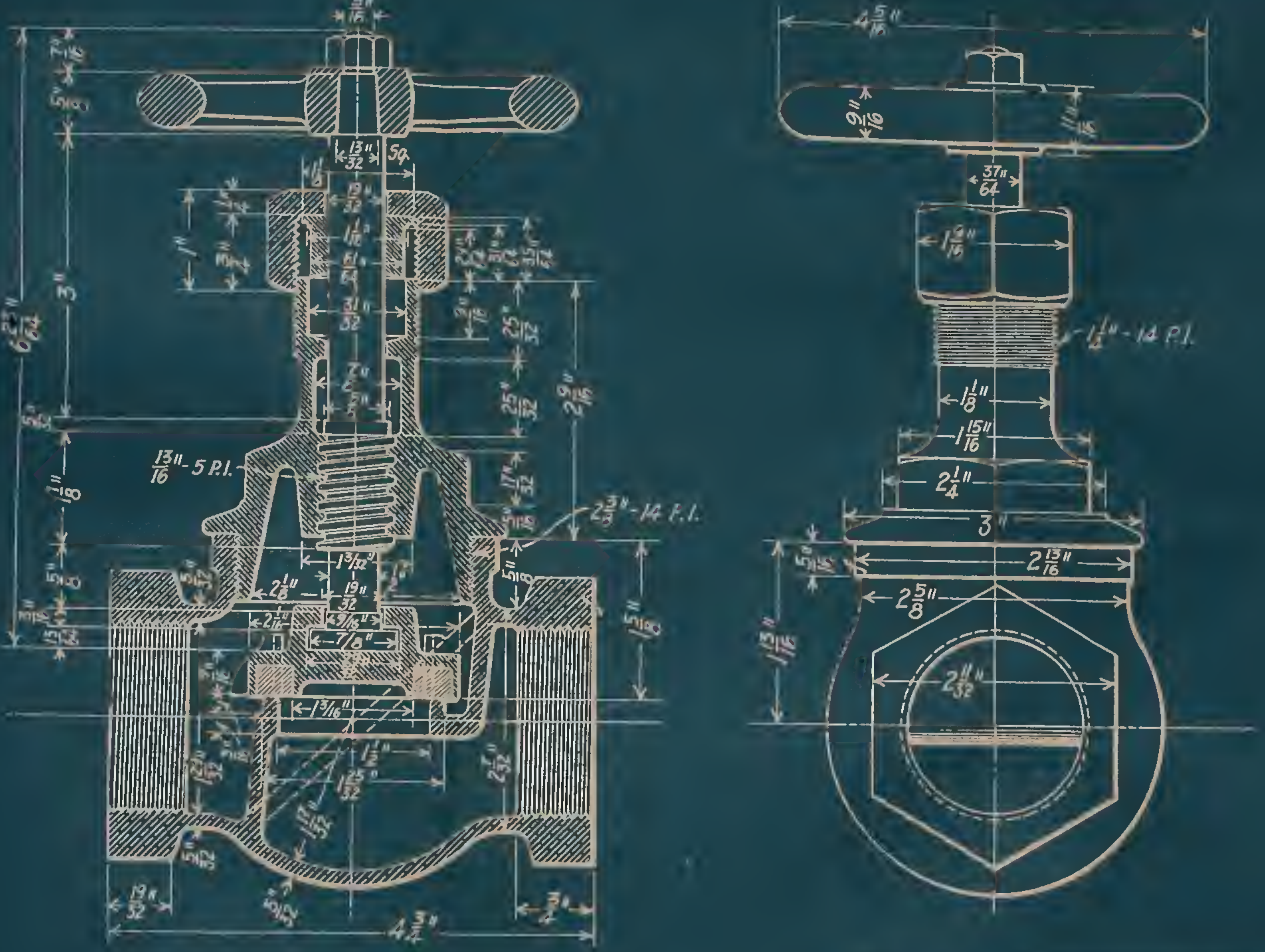
Diagonally drawn dotted lines in the end view represent a hole coming in from the front of the casting at an angle of 22 degrees 35 minutes. In the front view this hole and its boss show at the side as a series of full and dotted circles. A lettered note placed on the end view at the right of the vertical center line of the view states that an oil hole is to be drilled. Following carefully the lines which represent the oil hole, the reader will find that it is to be drilled at an angle of 17½ degrees with the center line of a similar $\frac{3}{16}$-inch hole showing through the lower side of the main hub hole. Further examination of the end view draws attention to two small circles at the sides of one of the ⅞-inch holes. A study of the small section view shows these circles to represent holes drilled, tapped, and counterbored for screws *H* having a ⅜-inch filister head. A radius arc drawn from the hole beside which these screw holes are placed shows that their centers are placed at $\frac{9}{16}$-inch radius. Other screw holes, oil holes, and pin holes can easily be located by a study of the views. In reading a blueprint such as this, especial care must be used in locating all center lines, radius lines, extension lines, dimension lines, and lines showing angles.

PLATE XIV

BRASS GLOBE VALVE

Plate XIV shows a 1½-inch brass globe valve and the original blueprint is made to full-size scale. Two views only are given. The front view shows the valve sectioned as if cut down through and on the center line, thus clearly giving an inside view of the valve. The end view gives an outline of the valve and is in a sense a picture of the valve. The arrangement of the cross-section lines in the front view indicates that the sectioned metal parts of the valve are, with the exception of the cast-iron handwheel, brass throughout. By means of the outline view and the section, the draftsman has not only shown all the necessary dimensions of the valve as an assembly but has also shown those of each detail so well that the machinist can work it out. While it is not general practice in shops to have the workman work from assembly blueprints, it may well be done when a shop is building a standard article. As there are no finish lines nor *f* marks, the workman would have to decide for himself what surfaces should be finished, if given this drawing to work from.

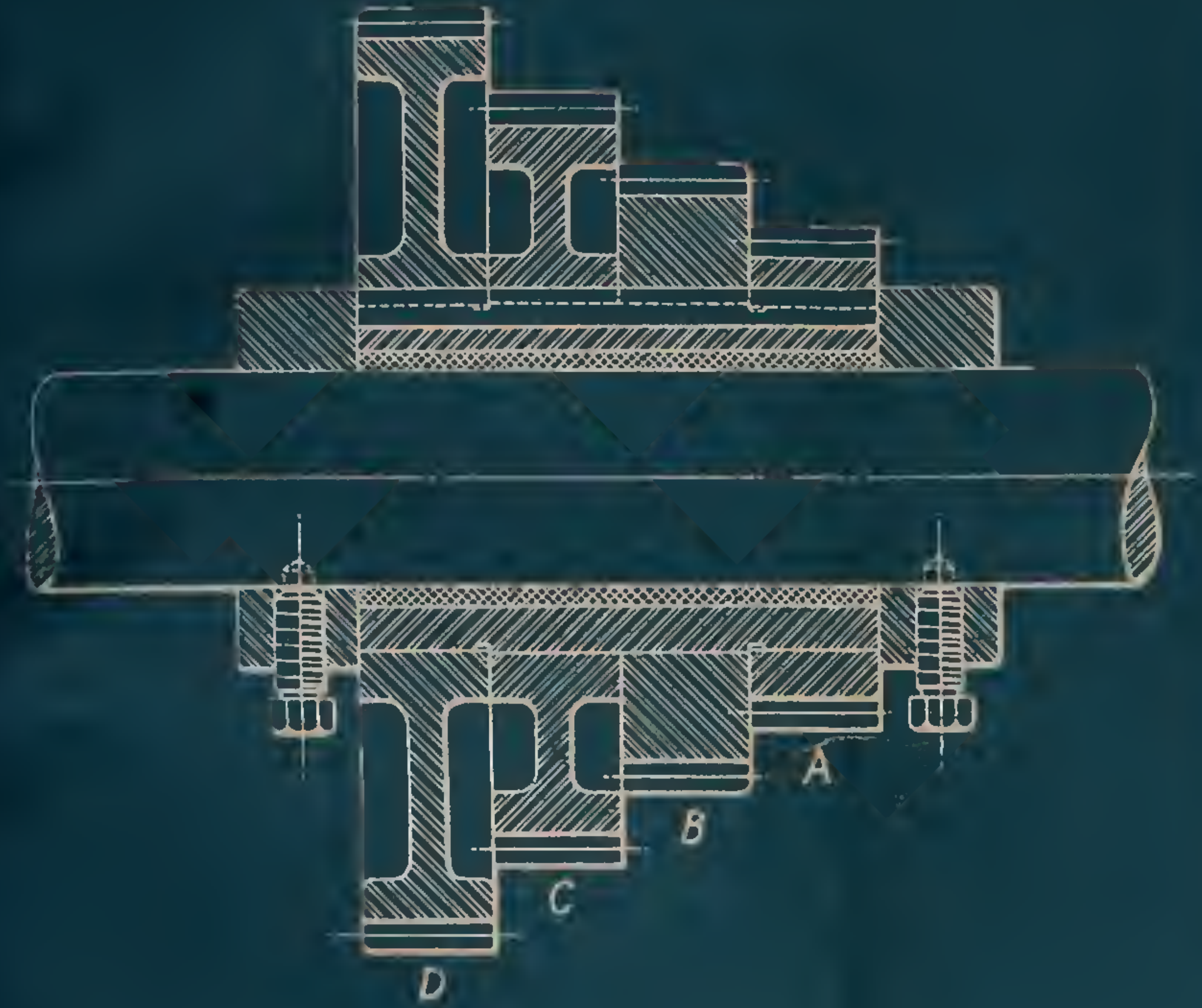
The several parts of the valve as shown on the blueprint are



BORE GUIDES 2 3/32"

SCALE *FULL SIZE*	1½" BRASS GLOBE VALVE
DRAWN BY F.P.R. TRACED BY B.X.B. CHECKED BY F.P.R. APPROVED C.R.K.	THE PRATT & CADY CO. INC. HARTFORD, CONN.

XIV



SIZE OF MACH.		NO. OF TEETH AND PITCH	OUTSIDE DIA.	WIDTH OF FACE	PART NO.
2	A	33 T. 8 P.	4.375	$1\frac{1}{8}$"	16810
	B	40 T. 8 P.	5.250	$1\frac{1}{8}$"	13625
	C	50 T. 8 P.	6.500	$1\frac{1}{8}$"	13606
	D	63 T. 8 P.	8.125	$1\frac{1}{8}$"	16808
3	A	31 T. 7 P.	4.714	$1\frac{1}{4}$"	16769
	B	39 T. 7 P.	5.857	$1\frac{1}{4}$"	10849
	C	48 T. 7 P.	7.142	$1\frac{1}{4}$"	12666
	D	60 T. 7 P.	8.857	$1\frac{1}{4}$"	16767
4	A	30 T. 6 P.	5.333	$1\frac{3}{8}$"	16898
	B	38 T. 6 P.	6.666	$1\frac{3}{8}$"	11448
	C	47 T. 6 P.	8.1666	$1\frac{3}{8}$"	11457
	D	58 T. 6 P.	10.000	$1\frac{3}{8}$"	16891
5	A	29 T. 5 P.	6.200	$1\frac{1}{2}$"	16904
	B	35 T. 5 P.	7.400	$1\frac{1}{2}$"	12160
	C	44 T. 5 P.	9.200	$1\frac{1}{2}$"	12158
	D	55 T. 5 P.	11.400	$1\frac{1}{2}$"	16902

PART NAME *DRAWING, ASSEMBLED CONE GEARS*

MACHINE NAME

USED ON *2-3-4-5- PA. UA- 2-3-4-VA. 2-UH & PH- 3-PH*

DRAWN BY *G.W.*

DATE ~~*FEB. 25. 09*~~ *MAY 25, 10.*

NO. WANTED

MATERIAL

CHECKED BY *S.E.*

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO.

AMOUNT

SHOP ORDER

PART NUMBER 15713

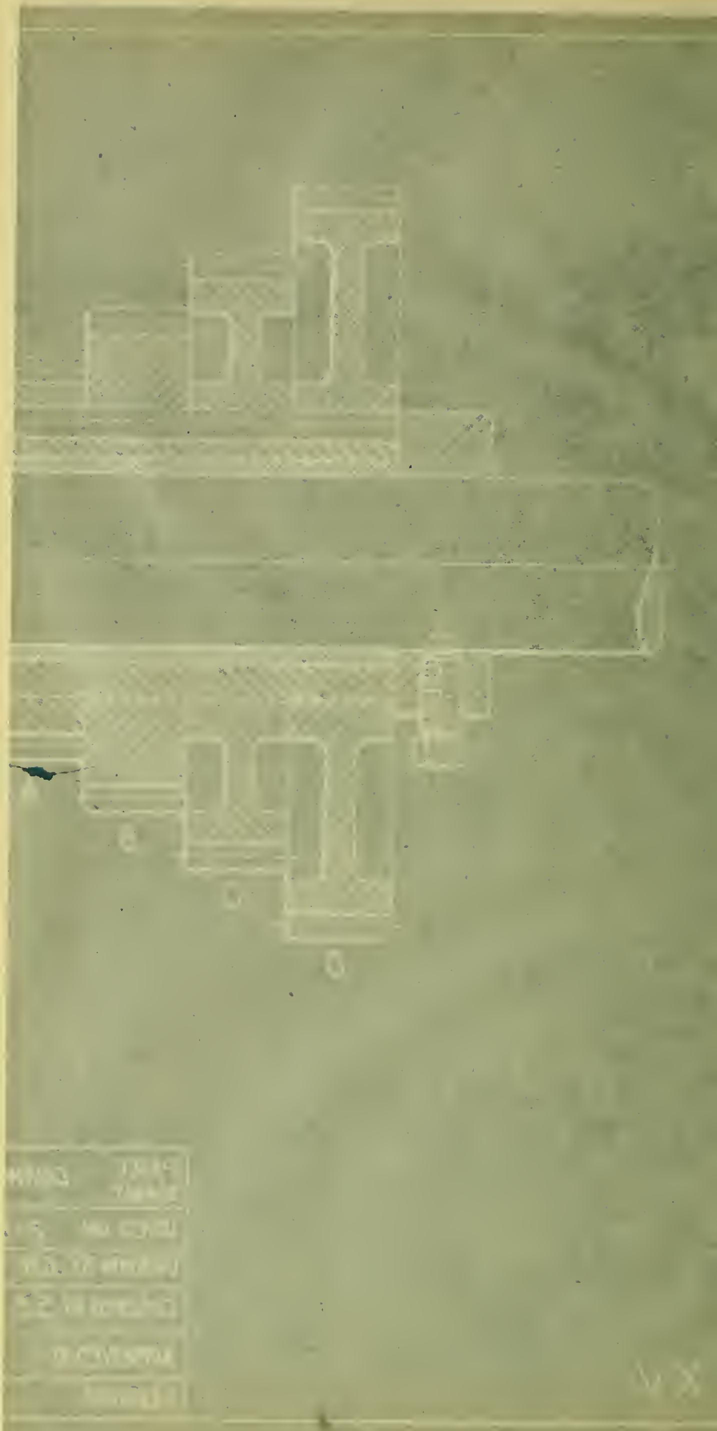
APPROVED BY

REMARKS

SUPERSEDES

SUPERSEDED BY

XV


A
B
C
D

the valve body, consisting of a globular shaped casting with threaded hexagon ends into which, on its upper side, is screwed the valve cover casting with a threaded bearing for the long spindle; and an upper part, consisting of a stuffing box for the wick packing. At the extreme upper end of the stuffing box are a small circular gland and a gland nut to force it along the valve spindle to compress the wick packing into the stuffing chamber. The valve spindle has on its top end a squared taper end to fit the cast-iron handwheel and a threaded hexagon nut to hold the handwheel in place. Toward its lower end an enlarged part of the valve spindle is threaded with a rather coarse-pitch Acme thread to fit the threaded bearing in the valve cap. The extreme lower end of the valve spindle is enlarged and finished to carry the valve disc which seats itself on the valve body seat to close the flow through the valve body from end to end. The disc, or upper, seat moves up and down in narrow guides, as shown in the front section view, and a lettered note placed just below this view states that these guides are to be bored $2\frac{3}{32}$ inches in diameter. The disc has in its lower, or seat, side a circular recess, $1\frac{15}{16}$ inches outside diameter by $1\frac{3}{16}$ inches inside diameter, for a fiber, leather, asbestos, or other seat ring. Two dotted lines about $\frac{3}{16}$ inch apart drawn diagonally across the inside of the valve body, as shown in the front view, represent a diaphragm rib. This is an interesting blueprint to read, as it is necessary to locate carefully all the *extension* lines to learn which *working* lines they extend. Care must also be taken to determine which lines many of the arrow points exactly touch.

PLATE XV

ASSEMBLED CONE GEARS

Plate XV illustrates a method of using an assembly drawing for shop purposes. The view shows a cone of four gears in section on a shaft. The arrangement of the cross-section lines indicates that the gears are made of machinery steel. As shown, the whole cone of gears is mounted on a steel sleeve which, in turn, runs on a composition sleeve. The whole combination is held in position on the shaft by steel collars having hexagon-head set screws. As is customary in such section views, the shaft is not shown sectioned.

Its ends, however, are shown as if broken off and the arrangement of the section lines at the break indicates that the shaft is of steel.

Immediately below each gear, as shown in the view, are placed the letters *A–B–C–D*. The first column of a lettered table placed in the upper right-hand corner shows that similar cones of gears are used on machines, size 2, 3, 4, and 5. The next column gives the number of teeth and the pitch of the teeth required in the gears *A–B–C–D* for the various sizes of machines. The remaining columns of the table give the outside diameter of each gear and its width of face. From this single section view, supplemented by the lettered table, the machinist should be able to get all the essential information for making these gears, with the exception of the hole diameter, which is not given. The two smaller cone gears are shown as if made from a plain steel blank, while the two larger gears plainly show that they have a distinct hub and rim with a thin web connection.

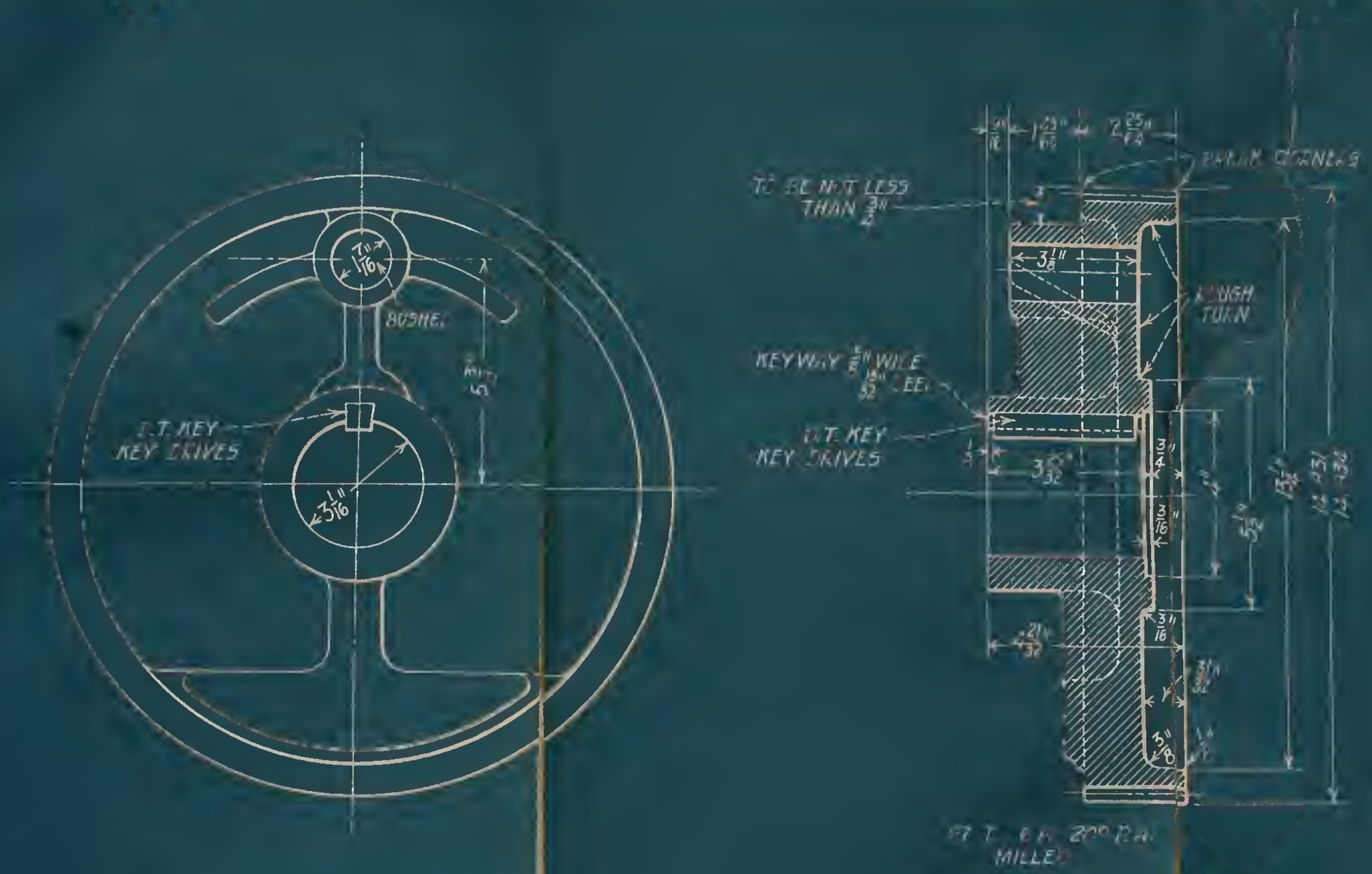
PLATE XVI

FACE GEAR

The two views of a special face gear shown in Plate XVI are half size in the original blueprint. The term "face gear" indicates that the piece represented is the large driving gear on the main spindle of the machine. While no finish *f* marks are found on the working lines of this blueprint, the average machinist would know that the outer diameter, the ends of the hubs, the holes through the gear, and the sides of the rim should be carefully and well finished. In addition to this, a lettered note at the upper right of the front view states that the surfaces indicated by the arrow points are rough turned. The title plate informs us that one is required and that the material is cast iron, which is also indicated by the arrangement of the cross-section lines in the front view.

The view looking toward the end of the gear hub shows that the upper small hub has a short supporting flange and that on its lower edge the upper hub is counterweighted. A lettered note placed just at the left of the front view tells us that the hole in the hub is keyseated $\frac{13}{32}$ inch deep and $\frac{5}{8}$ inch wide and that the key is dovetailed and drives into place. Both views show the key

19711



HALF SIZE

PART NAME GEAR, FACE

MACHINE NAME

USED ON

DRAWN BY C.F.S.

DATE AUG. 8 - 10

NUMBER WANTED & MATERIAL 1- C.I.

CHECKED BY P.M.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO

AMOUNT

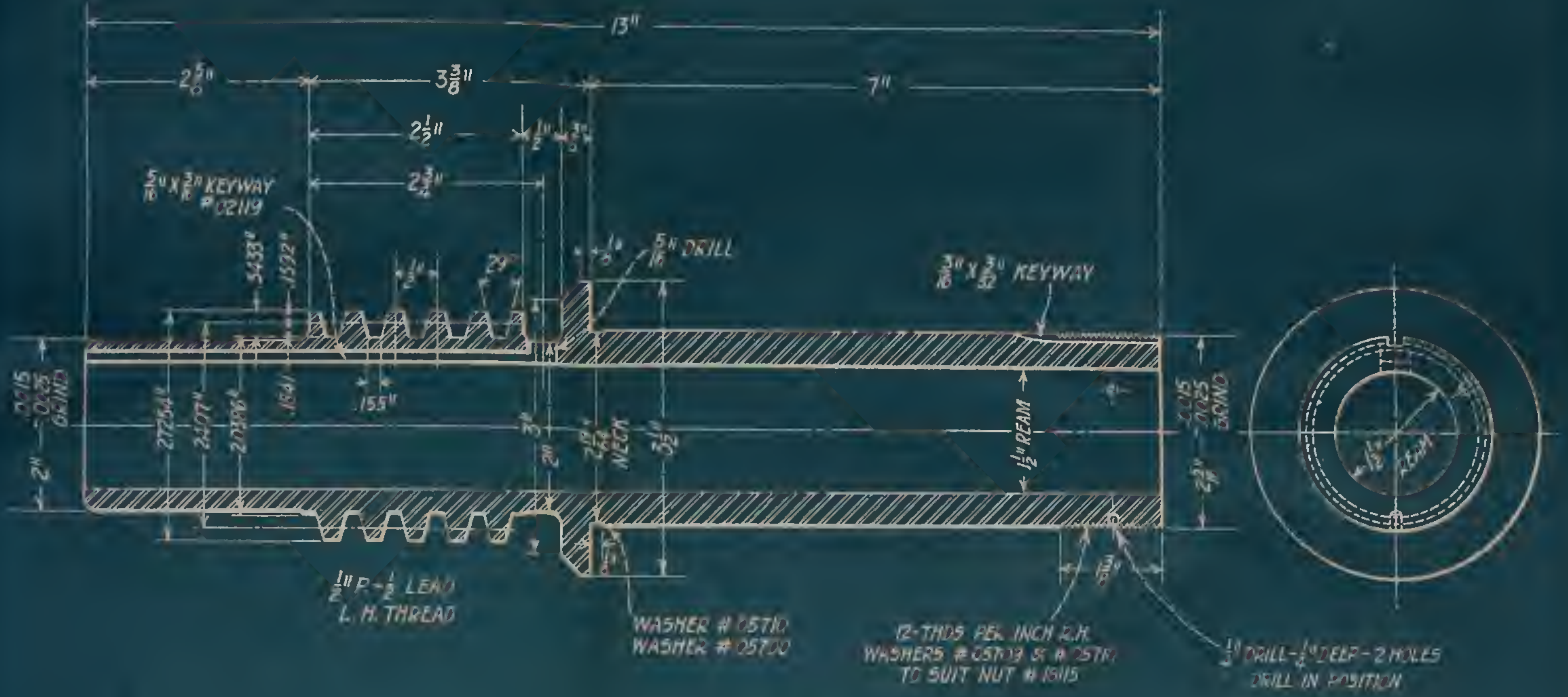
SHOP ORDER

PART NUMBER 19711

APPROVED BY

XVI

NAME OF PIECE	AMT. REQ.	NAME OF MACHINE	PIECE NO.
DOWN FEED WORM - R.H. HEAD -	ONE	5-FT. BORING MILL	14063



F. A. O.

	PIECE NO.
	14063

GROUP NO.	TRACED BY	DATE	CHECKED	THE CINCINNATI PLANER CO.	MATERIAL	USE PATT. NO.	SIZE	LENGTH
14011 14019	R.Gillham	4.20.17	F.A.		M.S.		3 1/2" ROD	13 1/8"

XVII

in place. Another important lettered note states that there are eighty-seven teeth milled into the outer face of the piece and that they are to be six pitch. The workman should especially note that the over-all diameter is to be held to definite limits of tolerance.

PLATE XVII

DOWN-FEED WORM

The upper title plate states that the piece shown in Plate XVII is a down-feed worm for a 5-foot boring mill. One is required and the lower title plate gives the material as machinery steel cut from $3\frac{3}{4}$-inch rod $13\frac{1}{8}$ inches long, rough dimensions. Two views are given, with the front view sectioned to indicate steel. All dimensions are given on the front view. The end view is sufficient to show that in general the piece has circular outlines. The end view also shows the shape of the two keyways and, while no direct dimensions are given, this view shows the general position of the holes mentioned in the lettered note, "$\frac{1}{4}''$ drill–$\frac{1}{4}''$ deep–2 holes–drill in position".

In considering this piece of work, the machinist is, of course, first concerned with the reamed $1\frac{1}{2}$-inch hole through its length. After this hole is finished ready for the mandrel, he should carefully read all the notes and other lettered directions before beginning to square up and turn the piece. He should especially observe what surfaces are to be ground and give careful attention to the finished dimensions. He will note that certain dimensions have a small limiting tolerance given in thousandths of an inch. He should also note that, while the fine-pitch thread shown on the right end of the front view is a *right-handed* thread cut to suit a certain nut, the coarse-pitch 29-degree worm thread is to be cut *left-handed.* All dimension lines, figures, and extension lines are very clear and are easily located in reference to their working lines. The lettered notes have clearly defined arrow points to indicate the surfaces to which they refer. Attention is called to the diameter dimension reading "$2\frac{19}{64}$ inches neck". This shows that the piece is to be necked in to this diameter previous to grinding the $2\frac{5}{16}$-inch diameter as a protection to the corner of the grinding wheel. No finish *f* marks are shown, as the piece is finished all over, and this fact has been indicated by the initial letters

F.A.O. placed just below the front view. The $\frac{5}{16}$-inch hole showing just to the left of the flange collar should be drilled before cutting the keyway to give a clearance for the cutting point of the keyseating tool.

PLATE XVIII

SADDLE ADJUSTING LEVER

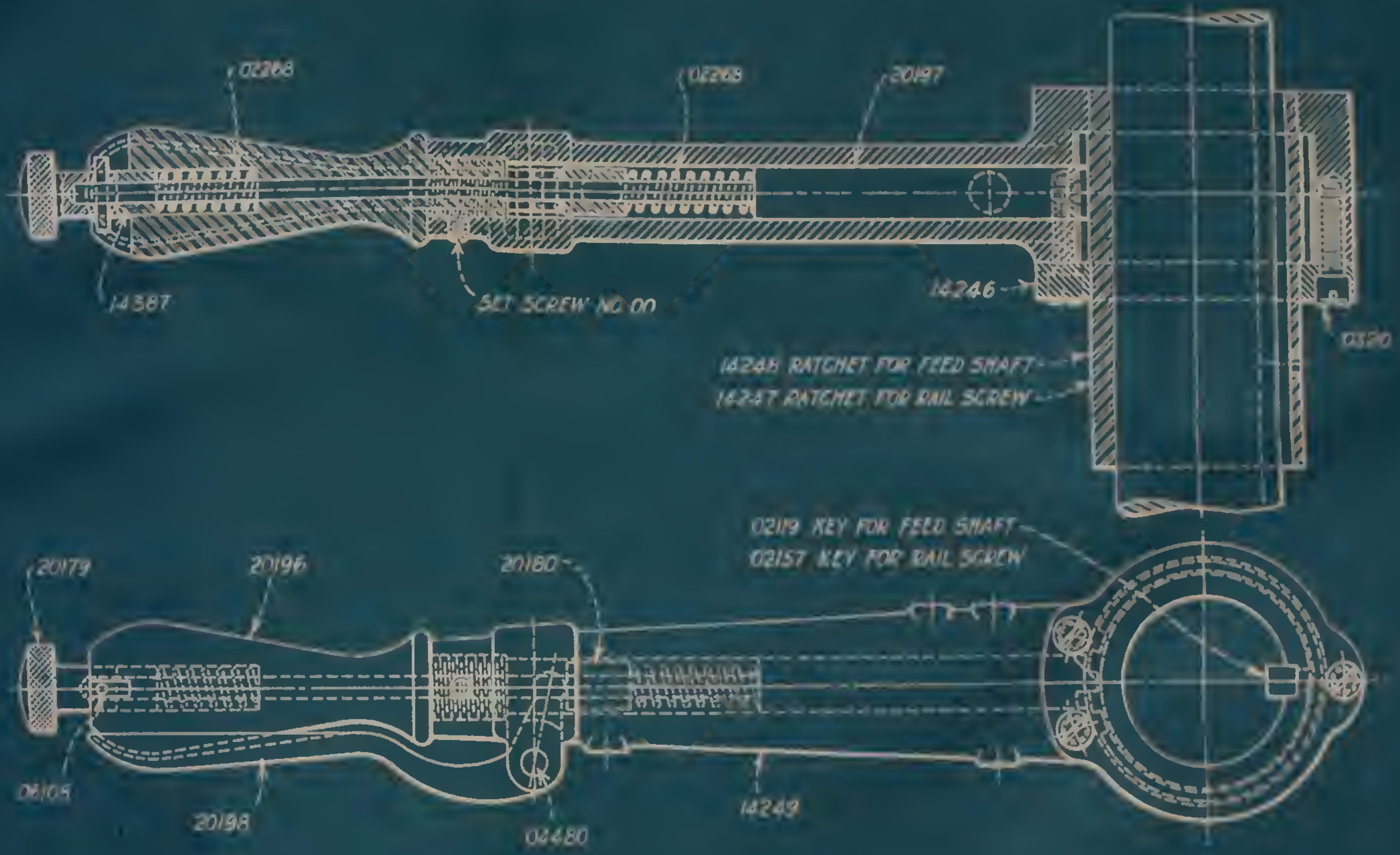
Plate XVIII, an assembly blueprint, is for the use of the setting-up machinist and clearly indicates how the group of parts which make up the saddle adjusting lever are assembled. It will be noted that each pin, cap screw, set screw, spring, lever arm, sleeve, etc., is given a part number and that an arrow point clearly indicates the part referred to. The arrangement of the cross-sectioning lines in the top view clearly indicates the material of each part; for example, they show that the lever arm *#14249* and its hub are cast iron, while the handle screwed into its upper end is of steel. While the shape and position of each part of this mechanism are clearly shown in this blueprint, no dimensions are given, which shows us that, as previously stated, the print is to be used in the shop only by the assembler. The reader in studying this blueprint should consider that he is to assemble the various parts and endeavor to decide in what order they should be assembled: for example, it is clear that *#20197*, *02268*, and *20180* must be placed in position in *#14249* previous to screwing *#20196* into it; also that *#14249* must be placed in position on *#14248* previous to attaching cover plate *#14246*.

PLATE XIX

TOP PULLEY BRACKET

The top title plate informs us that the several views shown in Plate XIX are of a top pulley bracket for a 5-foot boring mill and that two are required. The lower title plate states that the material is cast iron. The views are a front view, a right side view, and a top view, which is in this case projected and positioned just above the right side view. The arrangement of full and dotted lines indicates that the piece consists of a hollow base, or pedestal, having at its upper end a shaft-carrying box, or bearing, which, in turn, has a large grease, or oil, pocket on its upper side.

NAME OF GROUP	AMT. REQ.	NAME OF MACHINE	GROUP NO
SADDLE ADJUSTING LEVER	4	5 FT BORING MILL	14014

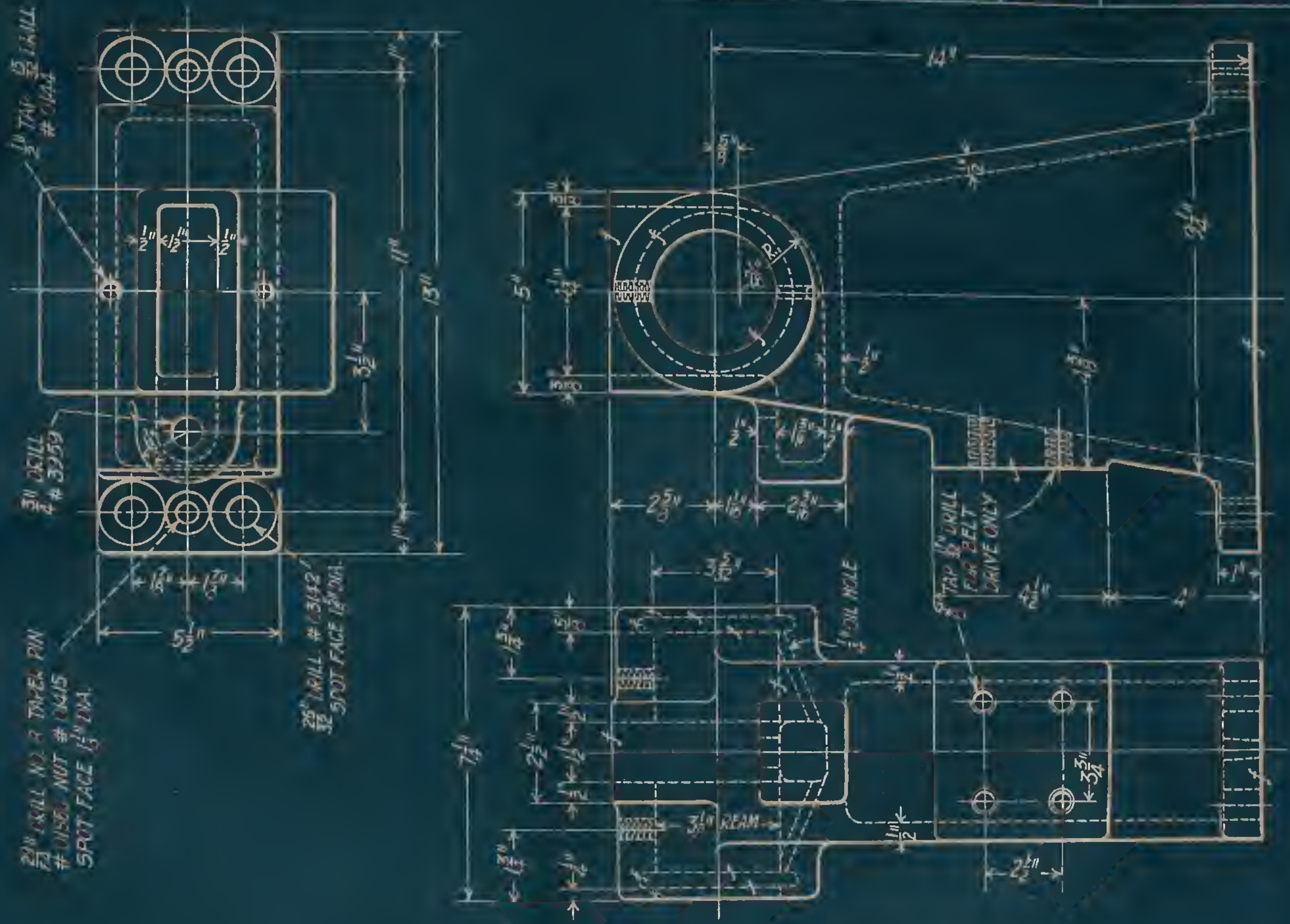


GROUP NO
14014

XVIII

GROUP NO.	DATE	CHECKED	The CINCINNATI PLANER CO.	MATERIAL	USE PATT NO	SIZE	LENGTH
14014	6.11.17	Fa					

NAME OF PIECE	AMT. REQ.	NAME OF MACHINE	PIECE NO.
TOP PULLEY BRACKET	2	5-FT. BORING MILL	14200



1/2" TAP 13/32 DRILL # 0144
3/4" DRILL 2 # 3959
23/32" DRILL NO. 3 TAPER PIN # 0158 NUT # 0415 SPOT FACE 1 3/8" DIA.
25/32" DRILL # 03142 SPOT FACE 1 3/8" DIA.
1/8" OIL HOLE
3/8" TAP 5/16" DRILL FOR BELT DRIVE ONLY
3 1/8" REAM
14"
11"
13"
1"
5 1/2"
3 1/2"
1/2"
5"
4 1/2"
9 1/2"
2 5/8"
1 1/16"
2 5/16"
3 5/32"
4 1/2"
4"
7 1/4"
2 1/2"
3 3/4"

PIECE NO.
14200

GROUP NO.	DATE	CHECKED		MATERIAL	USE PATT. NO.	SIZE	LENGTH
14005-14006 14002	5.14.17	Ja	THE CINCINNATI PLANER CO.	C.I.			

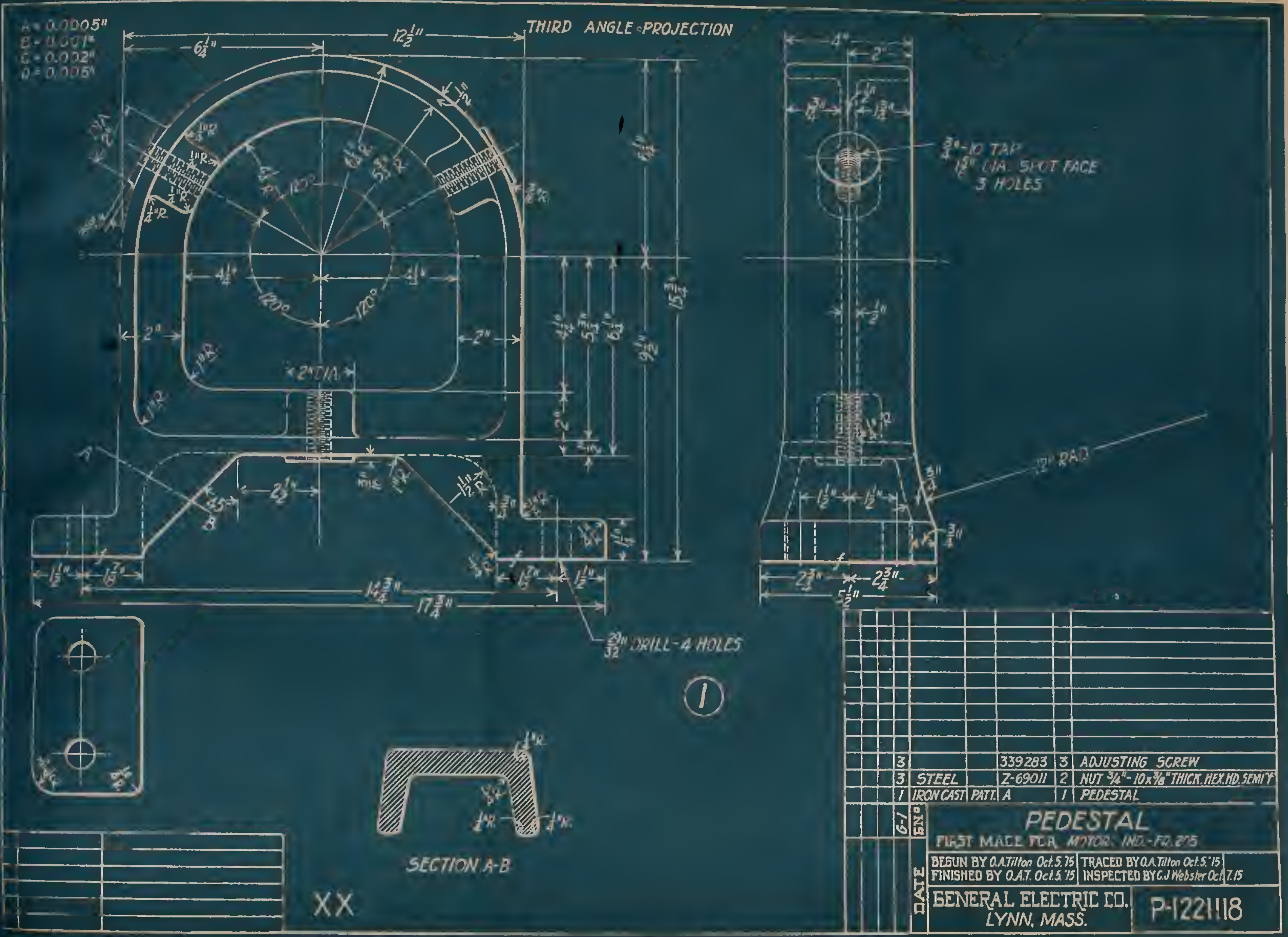
XIX

In reading this blueprint, the machinist should observe that many of the dimensions given are for the use of the pattern maker and are of no especial concern to him. The pattern maker, on the other hand, is concerned with all the dimensions as he must add sufficient stock to every surface marked with an *f* to allow excess metal for the machinist's purposes. As an instance of this, take some of the dimensions as given on the front view and the right side view. We observe that at the extreme right hand of the side view a dimension of 14 inches is given from the lower line, or base, of the pedestal bracket to the center line of the box. While this is a dimension for the machinist in particular, the pattern maker must also note that the base surface is to be finished and make the dimension enough longer than 14 inches so that the machinist will have metal stock sufficient to allow him to finish the base surface and still have the correct dimension. Also, in considering the shaft hole given as 3⅛ inches ream, the pattern maker must make his core prints and core boxes enough less than 3⅛ inches in diameter to allow stock for machining the hole to the specified size. The pattern maker only is concerned with the dimension ½ inch given for the wall thickness of the hollow pedestal and that of 9¼ inches given at the bottom of the side view for the width of the pedestal. These and many other dimensions are not subjected to any machining. The pattern maker, then, in reading this blueprint will carefully consider each and every working line, whether drawn full to represent a visible outside surface or drawn dotted to represent an invisible inside surface, in order to give himself a clear mental picture of the construction not only of the outer outlines of the piece but also of all the interior outlines. When the pattern maker has this clear mental picture of the piece, he can then readily trace the dimensions of all parts of his construction by following the extension lines.

If the pattern maker has fully understood the views up to this point he clearly sees: (a) that they represent a ring oiling pedestal bracket with the base cored out to leave walls ½ inch thick, the cored portion to extend up from the base line of the bracket to within ½ inch of the bottom surface of the cored oil chamber; (b) that the cored oil chamber is 4¼ inches in length in a direction across the shaft bearing and 1½ inches in width along the shaft hole, and that the oil chamber extends out toward the front of the bracket into a rounded-end projection, or lug; (c) that he must provide a loose pad on the front of the pedestal, as shown, "for belt drive only"; and (d) that the bottom surface of the bracket, the entire hole through the bracket box, the upper surfaces of the oil pocket, and the front face of the bracket pad are to be machined as indicated by finish *f* marks, and that excess stock for machining off must be allowed on such surfaces.

The machinist in reading the views should carefully note which surfaces are marked with the finish mark for machining. Starting at the pedestal base, as shown in the front and the side views, he will observe that its lower surface is to be machined and that certain holes are to pass through it. A study of the top view and its lettered notes shows that there are to be three holes through the base in each of its ends. Two of each three are drilled for holding-down bolts and one for No. 8 locating taper pins. The holding-down bolt holes are to be spot faced for the heads of the bolts.

Returning to a study of the front and side views, the machinist notes that the front surface of the pad is to be machined. This surface, as shown in the side view, is $4\frac{3}{8}$ inches from the vertical center line. Four $\frac{5}{8}$-inch tapped holes are to be drilled into the face of the pad $3\frac{3}{4}$ inches apart along the horizontal distance and $2\frac{1}{2}$ inches apart in the vertical dimension. Before machining the shaft bearing shown at the upper part of the front and the side views, the machinist should note: (a) that the bearing proper extends in length from the inner edge of a narrow circular oil-collecting pocket to the inner edge of a similar opposite circular oil-collecting pocket and that this bearing surface is bored and reamed to a diameter of $3\frac{1}{8}$ inches; (b) that outside of the circular oil-collecting pockets, the hole diameter is increased to $3\frac{5}{32}$ inches; (c) that while the circular oil-collecting pockets are marked *f* and are therefore to be machined, no dimensions are given, this indicating that they are simply machined to remove the original scale and to make them truly circular; and (d) that a large central oil-containing chamber is provided for an oil-conveying ring and that two oil-return holes are drilled from the edges of the two circular oil-collecting pockets at an angle which allows them to enter the



3			339283	3	ADJUSTING SCREW
3	STEEL		Z-69011	2	NUT ¾"-10x⅜" THICK. HEX. HD. SEMI "F"
1	IRON CAST	PATT.	A	1	PEDESTAL

6-1

EN°

PEDESTAL

FIRST MADE FOR MOTOR: IND.-FQ. 275

BEGUN BY O.A.Tilton Oct.5.'15
FINISHED BY O.A.T. Oct.5.'15
TRACED BY O.A.Tilton Oct.5.'15
INSPECTED BY C.J.Webster Oct.7.'15

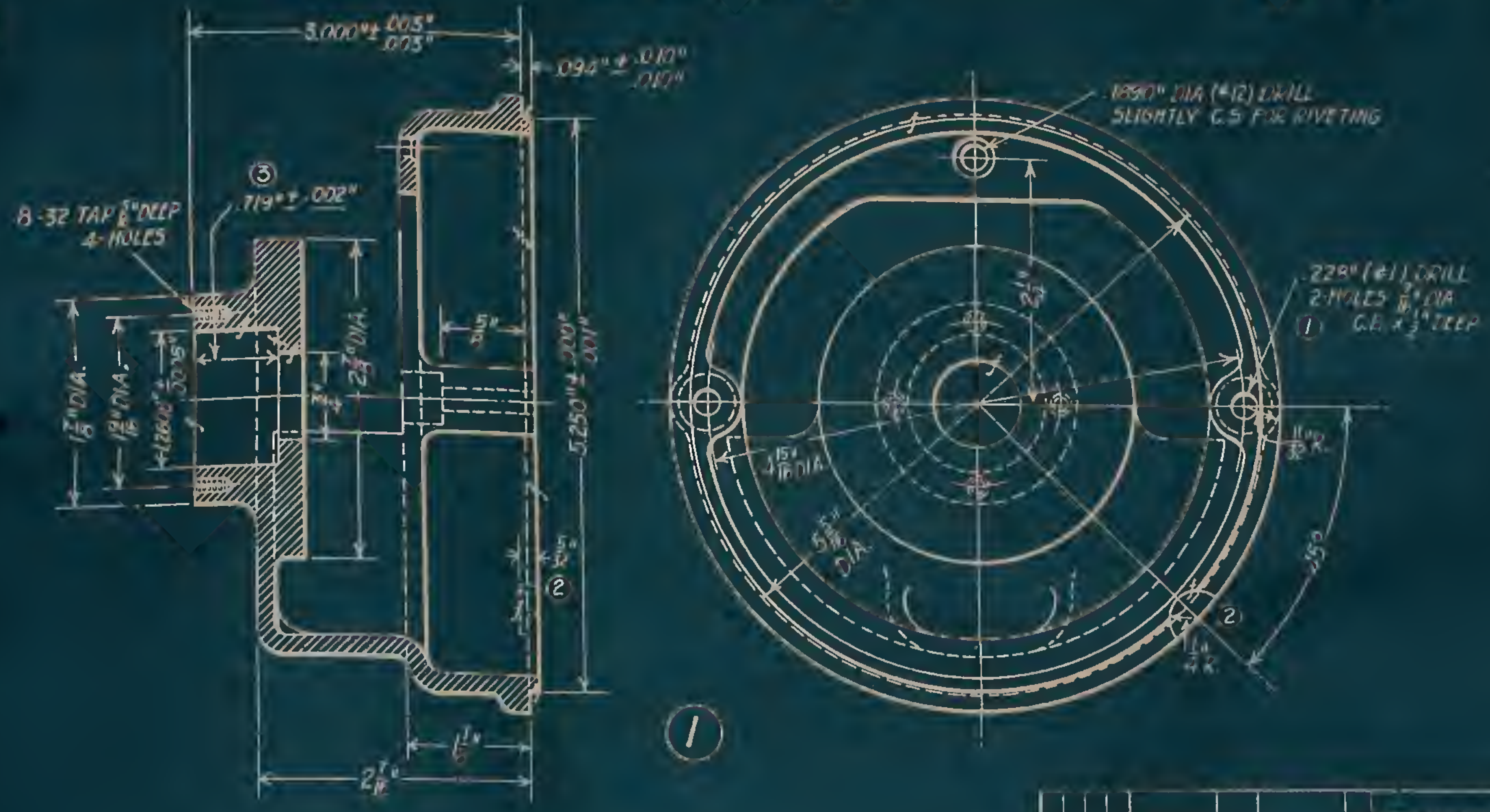
DATE

GENERAL ELECTRIC CO.
LYNN, MASS.

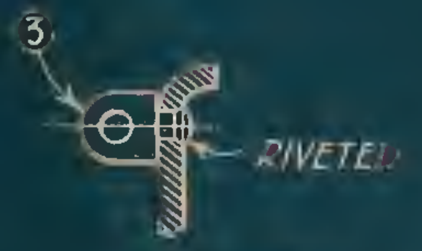
P-1221118

A = 0.0005"
B = 0.001"
C = 0.002"
D = 0.005"

THIRD ANGLE PROJECTION



①



⑥

			4	BRASS			11	MCH. SCR. [illegible]-32 x [illegible] HD
			2			Z 69018	10	LOCK WASH. PLAIN SPG. [illegible]
			1				9	BALL BEARING F&S A-12
			2	STEEL			8	MCH. SCR. #12-24 x 1" LG. FIL. HD. BLUED
			1			1.307.898	7	END CAP
			1				6	ASSEMBLY OF PARTS #1 & 3
			1	STEEL			5	COTTER PIN 1/16 DIA. 3/8" LG. STD FOR Rd 4
			1			1.307.904	4	PIN FOR #3
			1			373.762	3	HINGE
			1			1.305.181	2	COVER
			1	ALLOY #2	PATT.	283477-A	1	END SHIELD

GR. 1
GN°

END SHIELD

FIRST MADE FOR MOTOR DSD FR.26 REG. SW. 15974

DATE
BEGUN BY E. Socquet Jan. 15 '14
FINISHED BY E. S. Jan 17 '14
TRACED BY
INSPECTED BY C.J. Webster Jan. 17 '14

GENERAL ELECTRIC CO.
LYNN, MASS.

M-1,213,941

③	MAR. 20-1914	CH'D. PT. 1.
②	MAR. 13-1914	CH'D. PT. 1.
①	JAN. 27-1914	CH'D. #10 IN CAT. & DIM. OF #1

XX1

central oil-containing chamber, the lettered note stating that these oil holes are $\frac{1}{4}$ inch in diameter. Two threaded holes are shown through the upper shell of the shaft-bearing box and a note attached by a line and an arrow point to the upper view explains that they are to be drilled $\frac{13}{32}$ inch for a $\frac{1}{2}$-inch tap. Finally, the upper surfaces of the oil box are marked *f* to be machined.

PLATE XX

SHAFT-BEARING PEDESTAL

Plate XX shows a shaft-bearing pedestal in which the shaft-bearing box is a separate unit (not shown) which may be supported inside the pedestal. As the shaft-bearing box would be held exactly central with the frame of the pedestal, many of the working lines of the left side view are drawn around the center line, or axis, and several of the dimensions are figured as a radius from a common center. The views consist of a front, or edge, view, a left side view, and two smaller views, one of which is a section on line *A–B* and the other is placed just below the side view and shows a bottom view of the feet of the pedestal.

Very little machine work is to be done on this piece, merely machining the base supports on their under surface, drilling holes in the feet for four holding-down bolts, and drilling, tapping, and spot facing the three prominent bosses. It will be noted by the machinist that the latter holes are at an angle of 120 degrees with one another. The machinist should also observe that the base supports are to be finished to give their under surface a distance of $9\frac{1}{2}$ inches from the center line, or axis, of the views. Practically all the remaining dimensions are given for the pattern maker's use and are easily located and read.

PLATE XXI

END SHIELD

In reading the front view, the small view, and the right end view of Plate XXI, the reader should clearly see that when he looks at the right end view, he is in fact viewing this *end shield* at its large open end. A study of the front section view shows that the casting essentially consists of a large cup-shaped portion at the right with only a rim bottom. A half rim is attached and projects to the left and carries a circular hub having a circular hole of two diameters. In this blueprint the machinist, to understand the views, must carefully follow each working line of the drawing, locate each extension line, and note each arrow-pointed line.

All the important finished dimensions are given a limiting tolerance in thousandths of an inch. The rim edge of the large cup shown at the right of the front section view is finished to a 5.250-inch diameter and 0.094-inch depth; and three holes through the rim bottom are also finished. Two of these holes, $4\frac{15}{16}$ inches center to center, are counterbored for fillister-head cap screws, while the third hole, showing at the top of both views $2\frac{1}{4}$ inches up from the center line, is countersunk for riveting. A detail of this is given on the lower side of the blueprint. The circular hub which shows at the left of the front section view is machined on its outer end and a double-diameter hole is finished through it. Four holes are drilled and tapped into the outer face of the hub. A lettered note placed slightly to the left and above the hub gives the necessary information for these holes.

PLATE XXII

ARMATURE HEAD

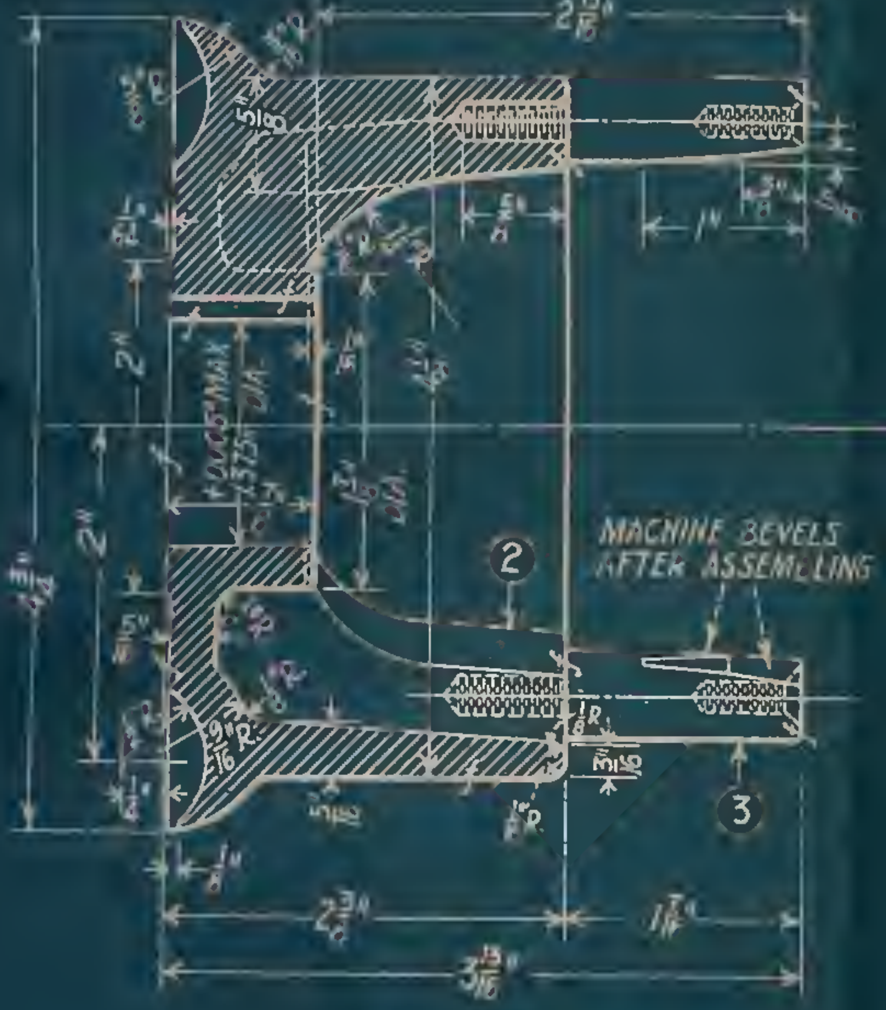
Plate XXII is a combined assembly and detail blueprint and according to the title plate is made up of ① armature head assembly, ② armature head, and ③ stud (fan-supporting), the whole being given the title plate name armature head. The numbers 1, 2, and 3 are clearly shown in the blueprint placed near or on the views. The material of the stud is given in the title plate as cold rolled steel and that of the armature head as soft steel casting. The front view is shown in section on line *A–B–C*. The careful reader will note that section line *A–B–C* follows the vertical center line of the right side view from *A* at its lower edge to *B* at the center axis and then slants to the right and upward, following the center line of one of the three ribs to *C*.

Stud. A study of the front and the end views shows that the studs ③ (also shown at the upper right of the blueprint) are screwed into the three ribs just mentioned, and a lettered note placed on the sectioned front view states that they are machined to a bevel after assembling.

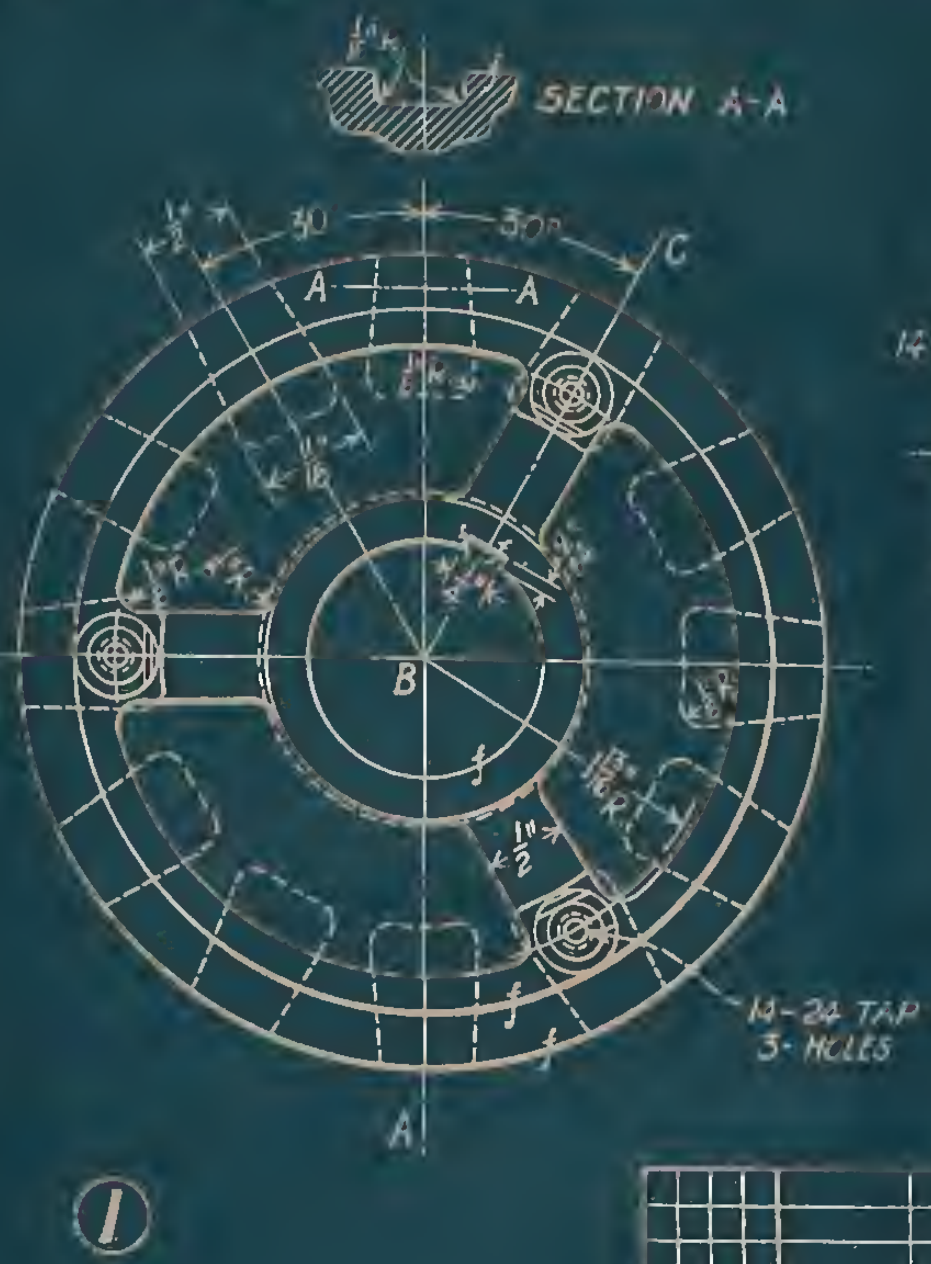
A
B
C
D

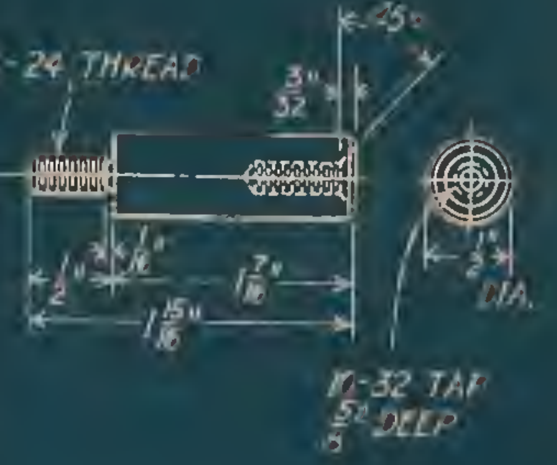
A- 0.0005"
B- 0.001"
C- 0.002"
D- 0.005"

THIRD ANGLE PROJECTION



SECTION A-B-C





XXII

3	STEEL C.R.	V		3	STUD (FAN SUPPORTING)
1	ST.CAST SOFT	PATT.	334236-E	2	ARMATURE HEAD
1	X			1	ARMATURE HEAD ASSEMBLY

G-1- GN°
SEPT. 30 1910 DATE

ARMATURE HEAD (FAN END)

FIRST MADE FOR MOTOR CVC-111-

BEGUN BY F. Dowe Sept. 30 '10
FINISHED BY F. D. Oct. 1 '10
TRACED BY F. Dowe Oct. 1 '10
INSPECTED BY E. Waller Oct. 3 '10

GENERAL ELECTRIC CO.
LYNN, MASS.

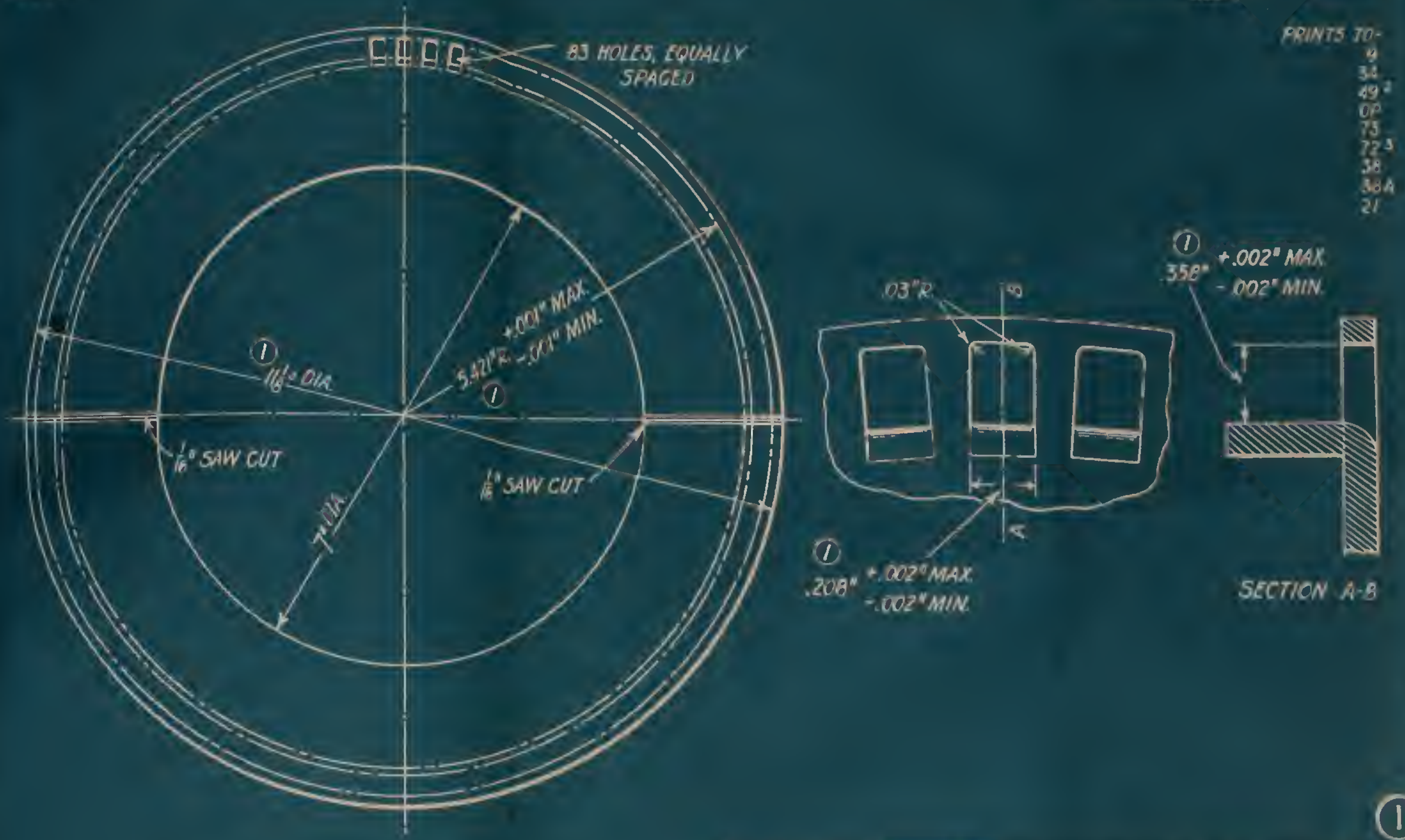
M-1,000,092-10.

A - 0.0005"
B - 0.001"
C - 0.002"
D - 0.005"

THIRD ANGLE PROJECTION

PUNCHED PART
COPPER SH. HARD .125" TH. MATERIAL

PRINTS TO-
9
34
49 2
OP
73
72 3
38
38A
21



C① FEB. 24 '09
CH'D DATE

XXIII - 1

FIRST MADE FOR
MOTOR GEN. SET M.I.C.
3 KW-1800-440/125
REG. N- 99438
DRAWN BY J. Osterberg

ARMATURE END RING

GENERAL ELECTRIC CO., LYNN, MASS.
DATE OCT. 8-08
A.S.
343066

A small detail section *A–A* placed just over the center of the side view shows the form of the slot on the section line *A–A* drawn across the upper edge of the side view. These slots, twelve in number, are shown by dotted working lines in the side view and are spaced evenly completely around the armature head at its extreme left end as the piece is shown in the front view.

Careful study of the views shows that the armature head casting is a circular cup having three narrow shallow ribs cast onto the inner side of its rim. It is into the outer ends of these ribs that the cold rolled steel studs are screwed, as shown. At the opposite, or base, end of the casting is located the outer flange for the slots shown in the detail section *A–A*. Extension lines drawn from the working lines of the flange carry a dimension line and arrow points which show that the flange diameter is $4\frac{3}{4}$ inches. The body rim of the casting is to be finished to an outside diameter of $4\frac{1}{8}$ inches. The hole through the hub of the casting, it should be noted, is finished to a diameter of 1.375 inches, with a tolerance of but one-half of one-thousandth inch above size and no tolerance below the figured diameter. The keyway is figured in the side view as being $\frac{1}{4}$ inch wide and $\frac{9}{64}$ inch deep. It must be noted that the keyway is located in the hub hole on the center line of a rib and not in the thinner part of the hub. The reader should observe that the radius of the rim side of the $4\frac{3}{4}$-inch flange is curved to a $\frac{5}{8}$-inch radius as shown at the upper left of the front view and that a corresponding radius of $\frac{1}{2}$ inch for the flange slots is shown at the lower left of the front view. The centers for these radius lines are shown as 2 inches from the center line of the piece and $\frac{1}{4}$ inch from the edge of the piece. A lettered note placed just below the side view gives the tapped stud holes as 14-24 tap–3 holes. The hole in the outer end of the stud is given as 10-32 tap–$\frac{5}{8}$ inch deep.

PLATE XXIII, Nos. 1 AND 2

DETAILS OF TYPICAL ARMATURE PUNCHINGS

General Data. Plate XXIII is made up of two D-size prints, each giving the details of a separate piece. For convenience in referring to them they have been given the numbers 1 and 2. Two other illustrations of a like construction are shown in Plate

XXIV. The pieces represented are punchings from sheet steel or sheet copper. The reader will note that a single complete view of each piece is shown supplemented by section details. The complete views, with the exception of blueprint No. 2 on Plate XXIV, are drawn to one-half scale in the original blueprint and the detail section views, in the original, are made to an enlarged scale about double size. These enlarged details show the form, size, and kind of holes to be made near the outer edge of the punching, as shown at the right of the complete views. A lettered note resting on an arrow states that there are to be eighty-three holes equally spaced around the punching.

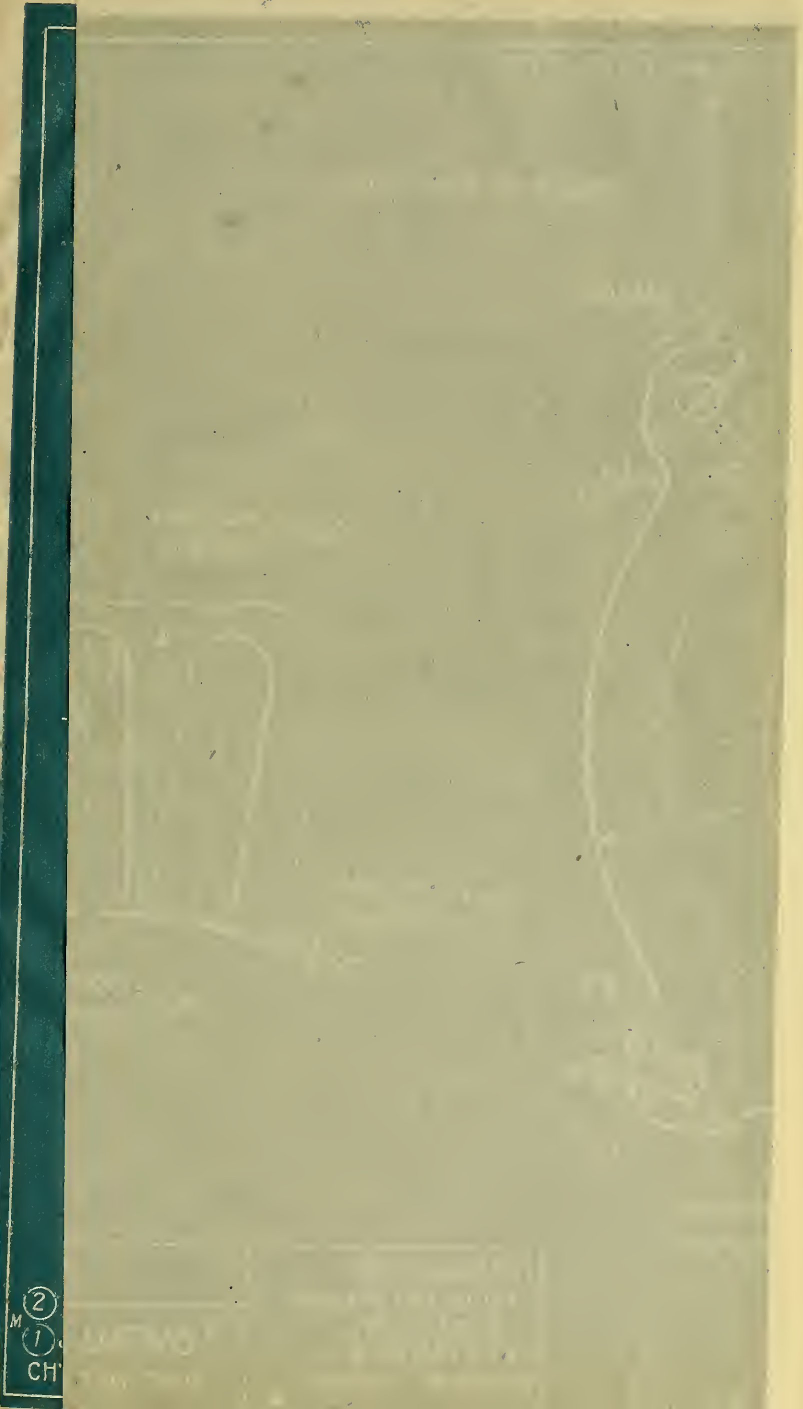
Armature End Ring. The title plate gives blueprint No. 1 as an armature end ring punched from hard sheet copper 0.125 inch thick. The holes and the entire punching are made by using what is known as a perforating and shearing punch and die. The metal punched out of the hole, in this case, is turned, or bent, inward as shown in the enlarged details. A note with two arrow pointers tells us that this punching has two $\frac{1}{16}$-inch saw cuts.

Armature Punching. Blueprint No. 2 is an armature punching punched from standard quality soft sheet steel 0.014 inch thick. A single view shows the complete punching. It has a 7-inch hole of a maximum tolerance of 0.001 inch above size and the outside diameter is 10.960 inches with a minimum tolerance of 0.006 inch. The punching is provided with a keyway $\frac{1}{2}$ inch wide and $\frac{17}{64}$ inch deep. The outer rim is provided with eighty-three slotted holes equally spaced around the circumference. An enlarged view of these slots is placed just to the right of the complete view. Lettered notes with arrowhead pointers give all the slot dimensions.

PLATE XXIV, Nos. 1 AND 2

DETAILS OF TYPICAL FIELD PUNCHINGS

Field Punching. In Plate XXIV are shown two blueprints of which No. 1 is a field punching punched from soft sheet steel, standard quality, 0.014 inch thick. One complete view only is given but, as in the blueprints shown in Plate XXIII, there is an enlarged view of the slots. This enlarged view gives complete details of the slots and the exact dimensions with all limiting tolerances. A note placed below the complete view tells us that the


②
M ①
CH

A = .00025"
B = .0001"
C = .0002"
D = .0005"

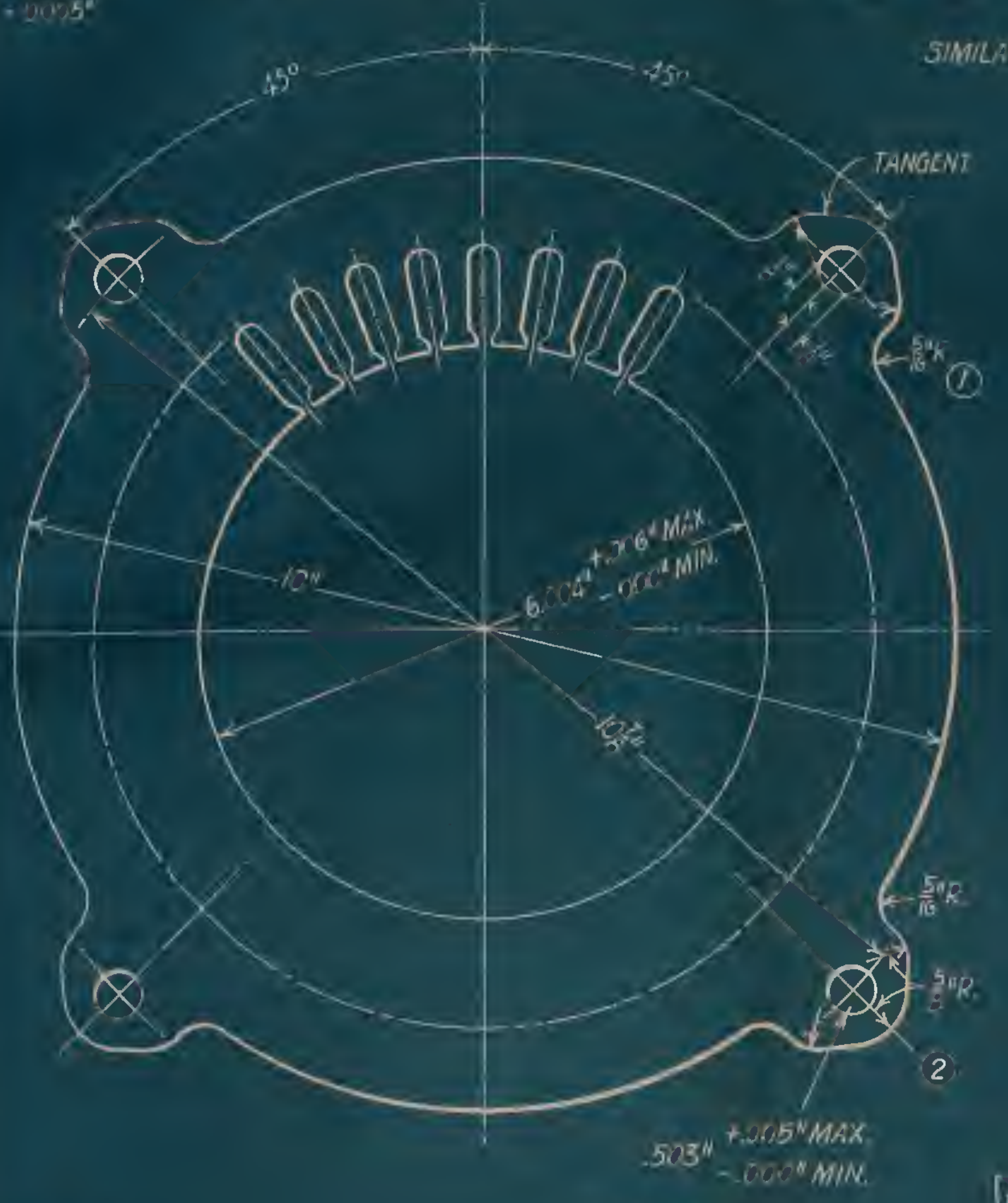
THIRD ANGLE PROJECTION

PUNCHED PART

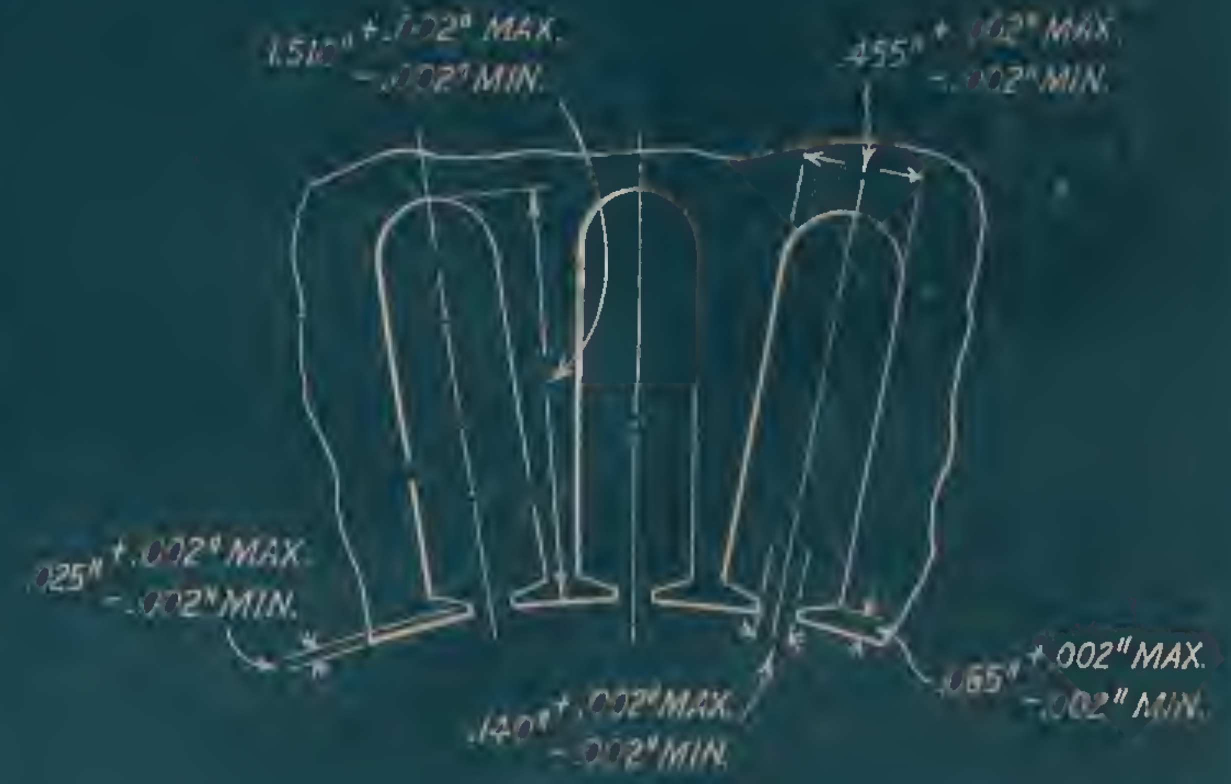
STEEL SHEET SOFT MATERIAL
STANDARD QUALITY
.014" THICK

SIMILAR TO PUNCH 10154

PRINTS TO:
49
9
54
72^{1}
OP
38^{2}
38A
21
6
142



36 SLOTS


1.510" +.002" MAX. -.002" MIN.
.455" +.002" MAX. -.002" MIN.
.025" +.002" MAX. -.002" MIN.
.140" +.002" MAX. -.002" MIN.
.065" +.002" MAX. -.002" MIN.

①

② APR 29 1911
① JUNE 23 '10
CH'D DATE

XXIV - 1

FIRST MADE FOR
MOTOR IND. KI FRAME
#140 A.C. 24
REG. 1372615 $\frac{2}{3}$
DRAWN BY Purinton

FIELD PUNCHING

GENERAL ELECTRIC CO., LYNN, MASS.
DATE OCT. 26 '08
343089

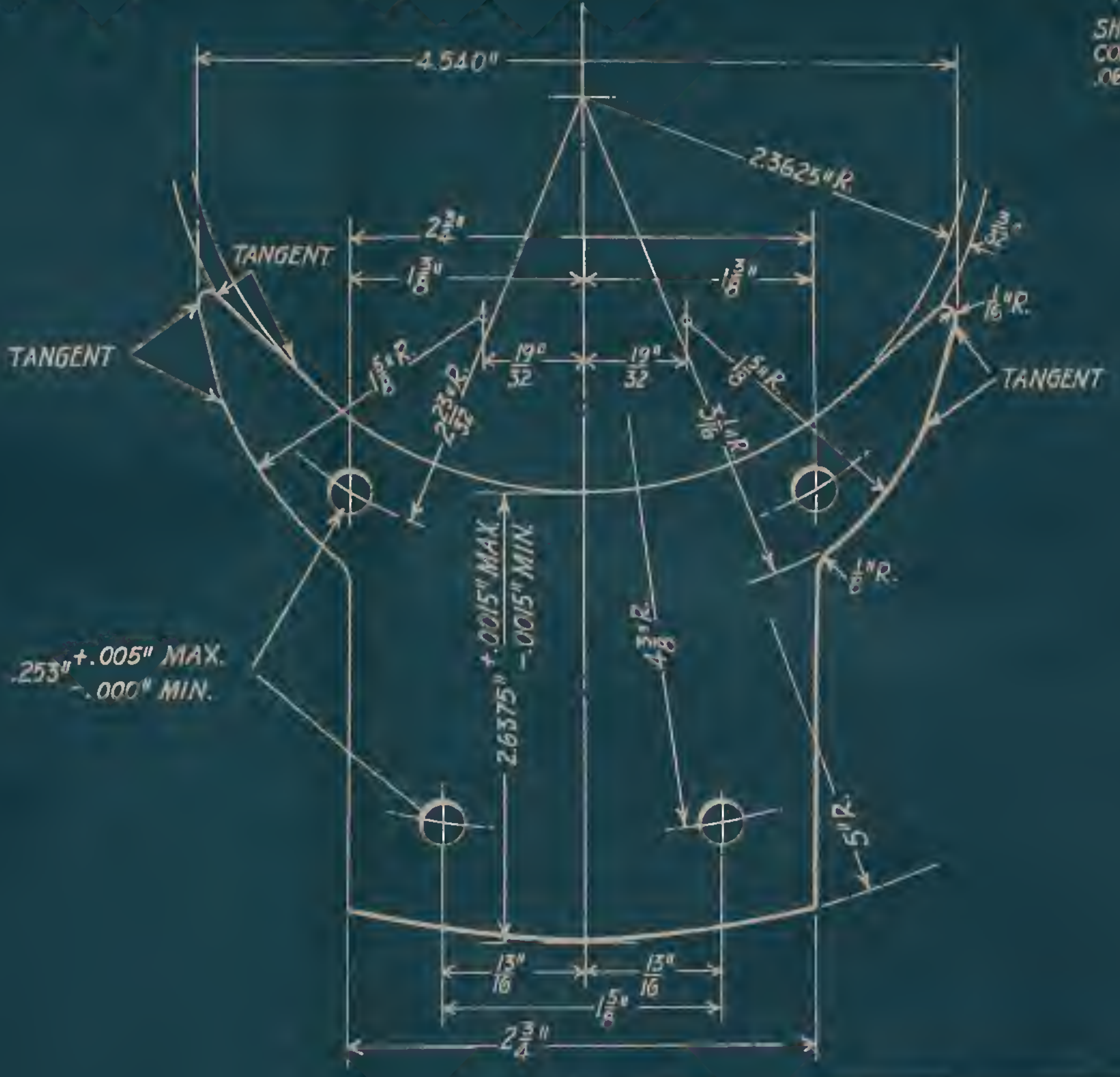
A = 0.0005"
B = 0.001"
C = 0.002"
D = 0.005"

THIRD ANGLE PROJECTION

PUNCHED PART

SHEET STEEL MATERIAL
COM. QUALITY
.0625" THICK

PRINTS TO-
9
34
73
49²
OP
72⁵
21
38
38A



②

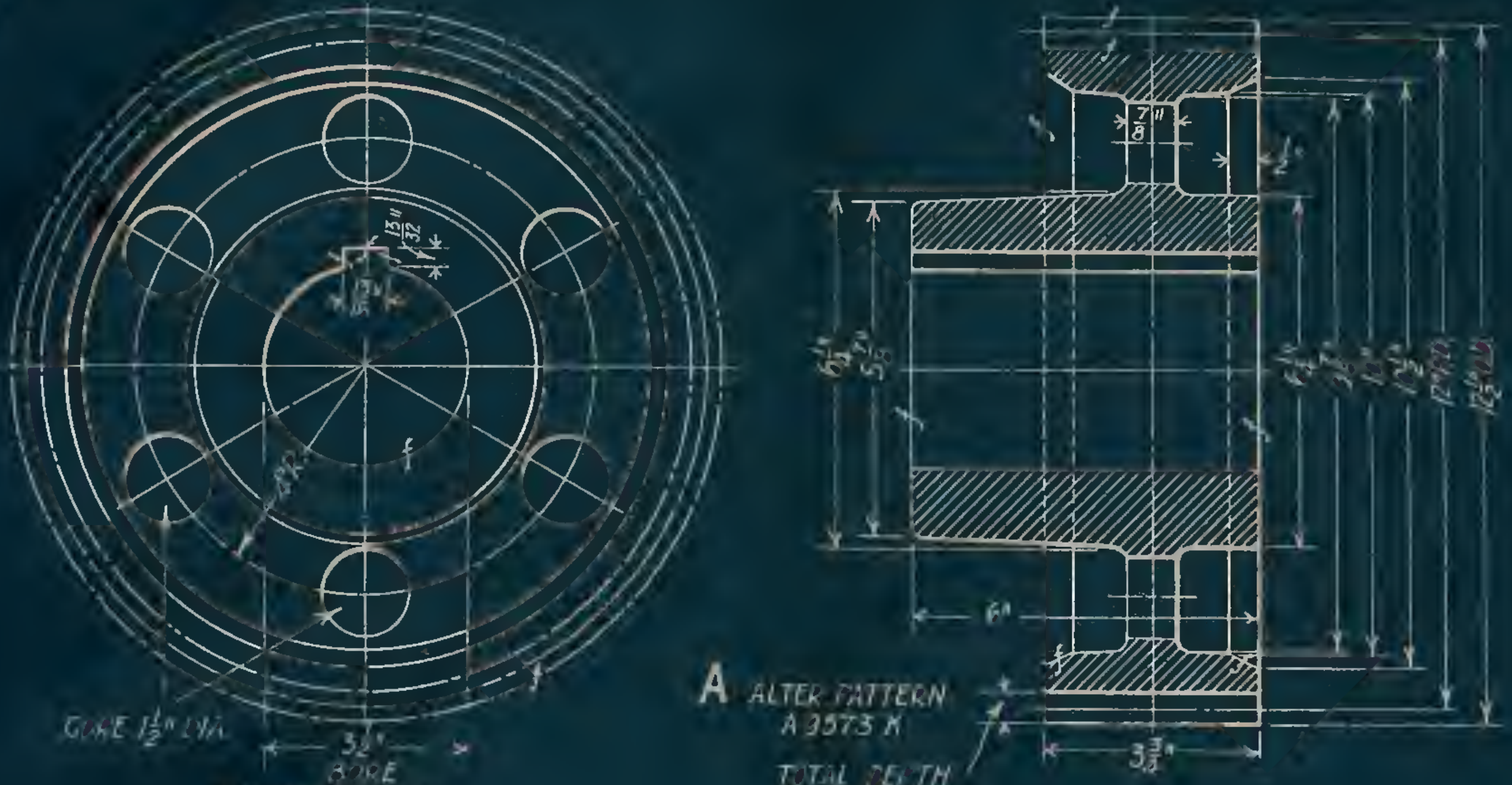
FIRST MADE FOR
MOTOR CR$\frac{3}{4}$ A.

DRAWN BY S. Ackerley
H.S.O.

POLE PIECE LAMINATION

GENERAL ELECTRIC CO. LYNN. MASS.
DATE OCT. 13 '08
343077

CH'D DATE XXIV - 2



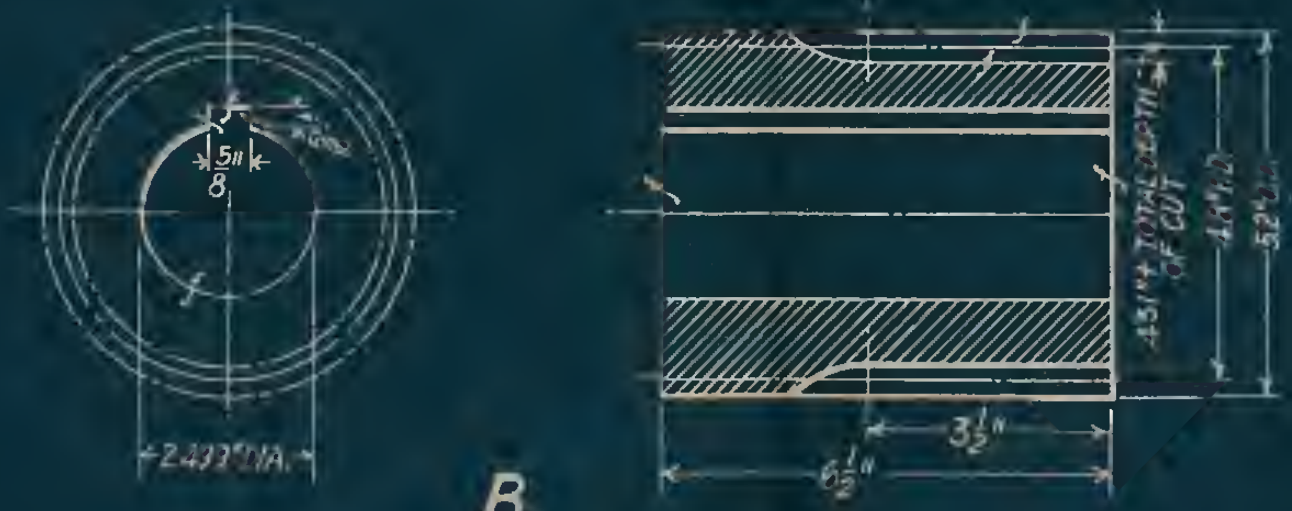
A ALTER PATTERN
A 3573 K

CORE 1½" DIA.

3½" BORE
18 TONS FORCE FIT

TOTAL DEPTH OF CUT .539"+

48-TEETH-HOBBED 14½°-INV.
4 DIA. PITCH
12" PITCH DIA.



B

24-TEETH-HOBBED 14½° INV.
5 DIA. PITCH
4.8" PITCH DIA.

·BILL OF MATERIAL·

MARK	NO. REQ'D	STOCK	DESCRIPTION
A	1	STEEL CAST .50-.60 & CARBON 60-80 MANG. TO BE THOR'LY ANNEALED	GEAR
B	1	C.H. STEEL FORGED .50-.60% C.	PINION

12" MERCHANT MILL
CONNECTING TABLE BETWEEN 2ND & 3RD PAIRS GEARS

SCALE 6 IN = 1 FT.
CONTRACT BETH. ST. CO.
DATE 3-7-17
DR. G.P.M. CH. J.P.M.
TR. W.E.J. APP. E.P.B.

REVISED			
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4		9	
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FROM
MORGAN CONSTRUCTION CO.
WORCESTER MASS.

B 22313

slots are thirty-six in number. The punching has four lugs on its rim placed 90 degrees apart. The outer contour of each lug, the careful reader will observe, is made up of arcs of circles connected by short straight lines drawn tangent to the arcs. This gives an irregular outline to the lugs. The die maker will, of course, note that many of the dimensions for this punching are exact to quite small limiting tolerances.

Pole Piece Lamination. Blueprint No. 2 is a pole piece lamination, and the upper note informs us that it is punched from sheet steel, common quality, 0.0625 inch thick. When the reader considers the thickness dimensions of the punchings shown in Plates XXIII and XXIV, he will readily see why an edge view is not given except at an enlarged scale, as in the several detail views. Plate XXIV, No. 2, is drawn full scale in the original blueprint. Only two dimensions show limiting tolerances. Most of the radius lines are from a common center placed somewhat above the view and on its center line. Centers for the other radius lines are clearly defined by small circles inclosing the center points. Radius lines are clearly drawn and dimensioned with the arrow points touching the working lines of the view. The die maker should carefully locate that part of the working line to which each radius line refers.

PLATE XXV

GEARS USED ON 12-INCH MERCHANT MILL

The title plate tells us that Plate XXV shows gears used on a 12-inch merchant mill. The bill of material states that one of these is made from steel casting thoroughly annealed and the other from an open-hearth steel forging. In the original blueprint the views are drawn to a scale of 6 inches to 1 foot. Where two gears are shown and one is larger than the other, the smaller of the two is the pinion and the larger is the gear, and in reading this blueprint they will be referred to in this way.

The pinion is shown in two views, with the front view in section as if sliced through the center of its length. The end view at the left of the front view clearly shows the hole and its keyway through the pinion; other than this, it consists of three concentric circles representing the outside diameter, the pitch diameter, and the root diameter of the pinion teeth. A lettered note placed just beneath the views tells the machinist that the pinion is to be hobbed and has twenty-four teeth of the regular 14½-degree involute form, five diameter pitch. The term diameter pitch refers the pitch of the teeth to the pitch diameter of the gear. Finish *f* marks show that the pinion is to be finished all over.

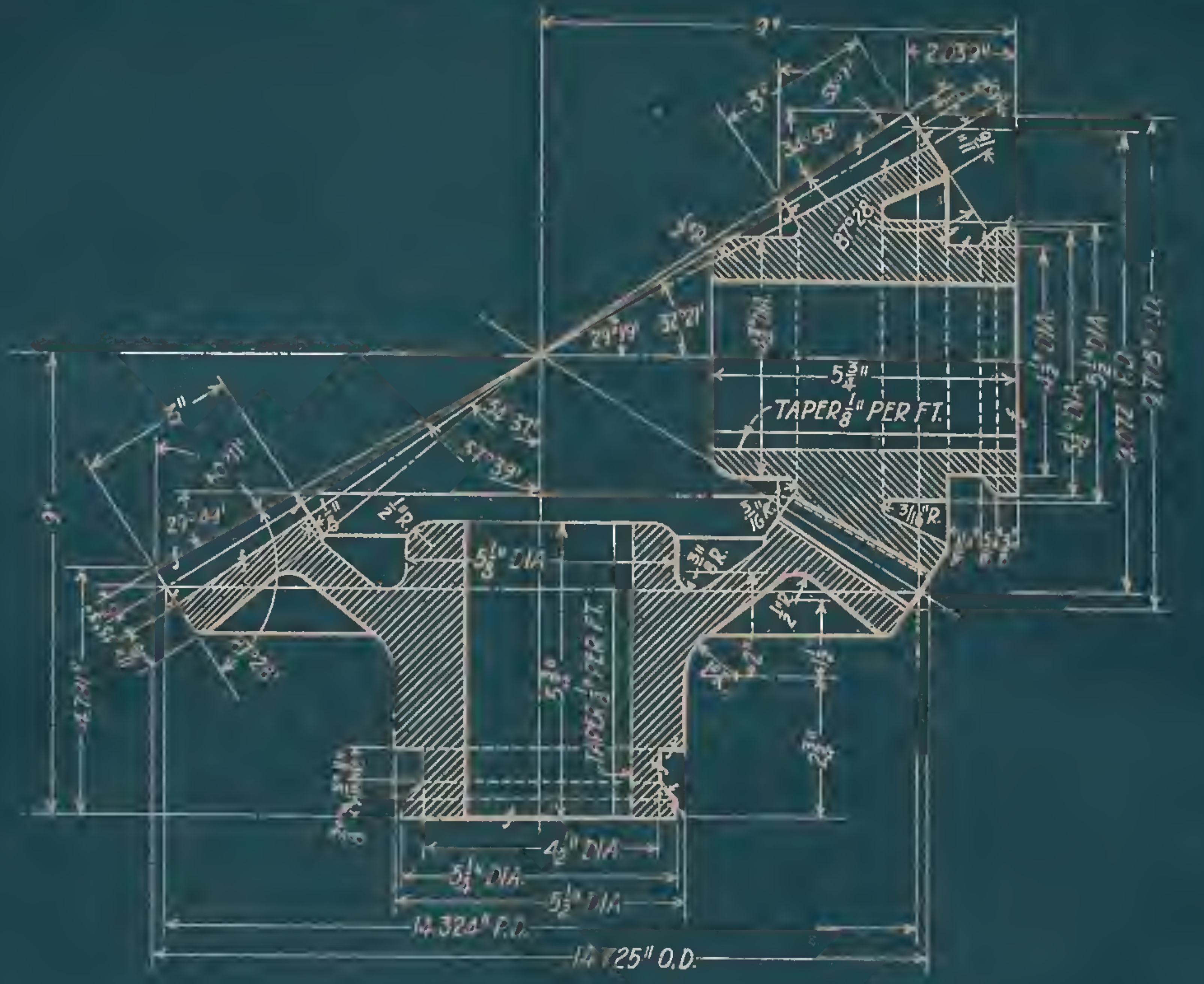
The views of the gear are arranged similarly to those of the pinion. Finish *f* marks show that the ends of the hub, the sides of the rim, the outer diameter of the rim, and the hole through the center are to be machined and that the inside of the gear rim on both its ends is chamfered as shown. The machinist should carefully note that the hole through the hub is bored 3½ inches in diameter and that the gear is to be forced onto its shaft with a pressure of 18 tons. The machinist should also observe that there are forty-eight 14½-degree involute teeth in the gear and that they are to be cut on a gear-hobbing machine. The pattern maker should especially note that there are six holes cored through the web of the gear. All dimensions and extension lines are clearly and plainly defined and so placed as to be easily read.

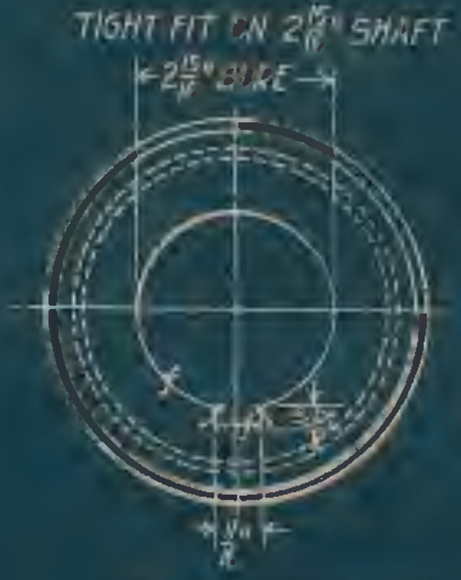
PLATE XXVI

BEVEL GEARS FOR ROLLS ON SHEET BAR AND SLAB-MILL STEAM FLYING SHEAR TABLE

The title plate of Plate XXVI informs us that the views shown represent a pair of bevel gears used on a 21-inch sheet bar and slab mill steam flying shear table. The bill of material shows them to be open-hearth steel castings thoroughly annealed. The front view of the gears is sectioned by a plane along their axes and shows the gear and the pinion with their teeth engaging, or in *mesh* as it is called. A pair of bevel gears are usually shown thus, and the reader should make himself familiar with this fact and should study every detail. The end view of the pinion and the end view of the gear are just sufficiently complete to show the hubs and the holes and keyways through the hubs.

A lettered note *A* states the number of teeth in the pinion, the form of the teeth, the pitch of the teeth, and how they are to be machined. A lettered note *B* gives like information for the gear. When reading these lettered notes, the machinist should

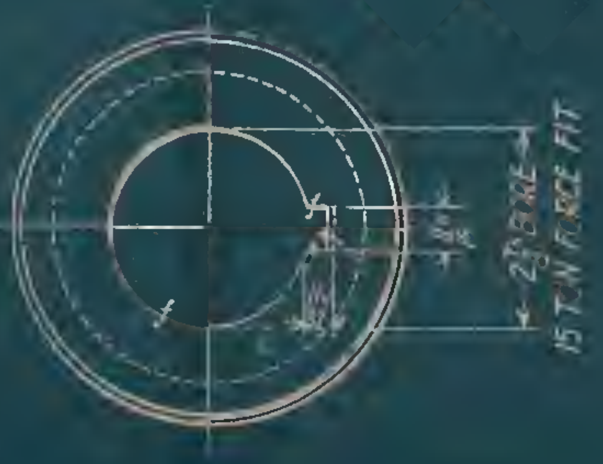




A 19 FINISHED TEETH
PLANED TO 20° INVOLUTE
1½" CIR. PITCH
9.072" PITCH DIA.
9.705" OUT. DIA.

BILL OF MATERIAL			
MARK	NO. REQ'D	STOCK	DESCRIPTION
A	1	O.H. STEEL	GEAR
B	1	SMOOTH	GEAR
		CASTING	
		[illegible] C. S[illegible]	
		[illegible] & MANG. TH-	
		OROUGHLY ANNEALED	

B 30 FINISHED TEETH
PLANED TO 20° INVOLUTE
1½" CIR. PITCH
14.324" PITCH DIA.
14.725" OUT. DIA.



21" SHEET BAR & SLAB MILL · STEAM FLYING SHEAR TABLE · BEVEL GEARS FOR ROLLS

SCALE 6 IN = 1 FT
CONTRACT SHARON S.H.CO.
DATE 3-12-18
DR. W.S.S. CH. [illegible]
TR. L.B.R. APP. [illegible]

REVISED			
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4		9	
5		10	

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MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

B 23162

B 23162 XXVI

not fail to observe that the gear teeth are 20 degrees involute instead of the ordinary 14½ degrees, also that the pitch of the teeth is given as circular pitch instead of the more common diameter pitch. Circular pitch is the distance from the center line of a tooth to the center line of the next tooth and is measured along the pitch circle. In bevel gearing, it is measured at the largest pitch diameter.

The machinist, after carefully reading the lettered notes, is next concerned with the holes through the hubs of the gear and of the pinion. He will note that the gear is to be forced onto its shaft with a pressure of 15 tons and that in the pinion the hole should be a tight fit on the shaft. He will also observe that each keyway is to taper at the rate of ⅛ inch per foot. The machinist's next concern is the outside diameters of the gear and of the pinion. By following the extension lines to their dimension lines he learns that the gear is 14.725 inches and the pinion 9.705 inches outside diameter. He then locates the angles which give him the cone form of the pinion and the gear blank and notes that they are given in degrees and minutes. By using a bevel protractor in his measurements he can readily machine the cone sides and edges to the required angles as given on the blueprint. Making the length of the tooth an even 3 inches as given completes the pinion and the gear blanks (so far as the tooth rims are concerned) ready for cutting the teeth. The back end of each hub is faced up and its end circumference is machined into a circular groove of definite dimensions which are easily found and noted.

Previous to planing the teeth, the machinist should locate the angle marking the bottom of the tooth space. This angle is known as the *cutting angle,* and in this blueprint the reader will find it for both gear and pinion near where the center lines of the gear and the pinion cross each other. For the gear, the cutting angle is 54 degrees 37 minutes and for the pinion it is 29 degrees 19 minutes. The total depth measured at the outer end of the teeth should be noted. This is given as ⅜ inch+0.45 inch. As such gears as these are usually planed on a special gear-tooth planer, no further directions need to be given. The pattern maker will find in this blueprint all the necessary dimension lines, radius lines, and figured angles for a complete pattern for each gear.

PLATE XXVII

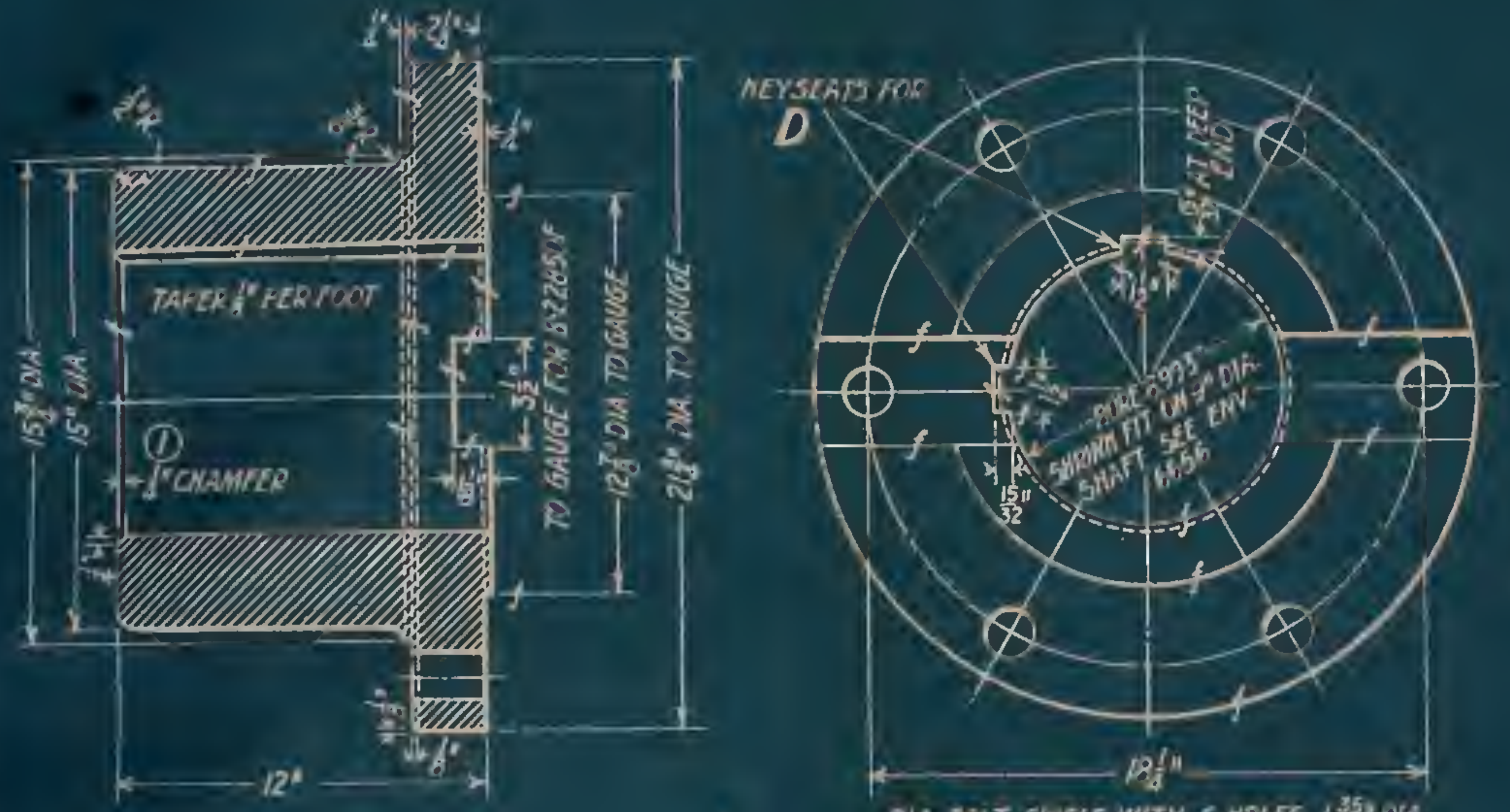
MOTOR COUPLING FOR ROD MILL DRIVE

Plate XXVII shows the parts of a motor coupling for a rod mill drive. The bill of material notes six parts *A–B–C–D–E–F* and gives the material from which each part is made and the number of each required. In the original blueprint all the views are one-quarter size, 3 inches to 1 foot. Lettered note *1* gives special shipping directions, and a most important note placed in the center of the end view gives explicit directions regarding the size of the hole and states that it is to be shrunk on the motor shaft. The front view of the coupling body *A* is sectioned through the center of its length. For the pattern maker, this is a simple job and he can make no mistakes in finding his dimension lines and figures.

The machinist who carefully reads the views will note that many of his dimensions are given to a special fixed gage. The note on the end view states that the hole is to be bored 0.007 inch small to allow a shrink fit. The keyway in the side of the hole is to be tapered $\frac{1}{8}$ inch per foot. A note at the hub end of the front view shows that this end of the hole is to be chamfered.

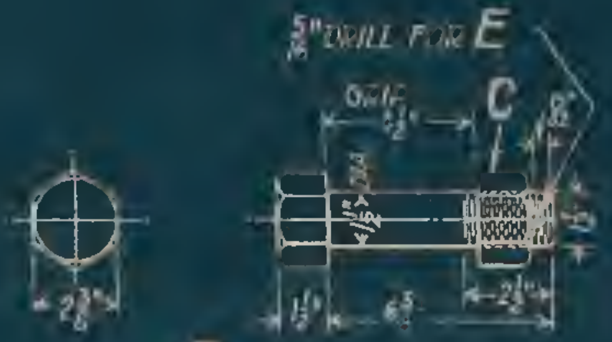
There are two hole keyways $\frac{15}{32}$ inch deep at the deeper end and a broad shallow keyway across the face of the flange part of the coupling, $1\frac{1}{8}$ inches deep and $3\frac{1}{2}$ inches wide to gage. Finish *f* marks on the working lines of both views indicate that the piece is machined all over. The smaller details of the coupling *B–C–F* are given near the right end of the blueprint. *F* shows two views of the key which fits the broad keyway machined across the face of the coupling flange; one end of the key is curved, as shown, to a radius of $10\frac{7}{8}$ inches. A $1\frac{9}{16}$-inch hole is shown drilled near the curved end and this helps us to understand that a flange bolt *B* passes through this end of the key when it is fitted in place in the face of the flange. The width dimension shows that it is to gage. The flange coupling bolts *B* with their nuts *C* are shown by a front and an end view. The front view shows the nut *C* in place, which is a common way of showing bolts and nuts. A hole is shown drilled through the body of the bolt near its threaded point for a $\frac{5}{16}$-inch cotter pin. The end view gives the shape of the bolt head and nut and shows it is chamfered at its outer corners.

1530 DIA
B 2

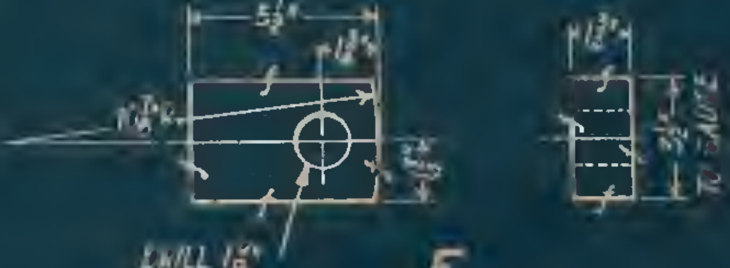


DIA. BOLT CIRCLE WITH 6 HOLES $1\frac{35}{64}$" DIA.
DRILLED TO JIG

A



B



F

·BILL OF MATERIAL·			
MARK	NO. REQ'D	STOCK	DESCRIPTION
A	1	O.H. STEEL CAST .20%-.30% C.	COUPLING
B	6	STEEL	$1\frac{1}{2}$" DIA. BOLT $6\frac{5}{8}$" LG.-HEX HEAD
C	6	STEEL	$1\frac{1}{2}$" STD. HEX. NUT
D	2	KEY STEEL	$1\frac{1}{2}$" x $\frac{15}{16}$" KEY $11\frac{3}{4}$" LG. $\frac{1}{8}$" TAPER PER FT.
E	6	STEEL	$\frac{5}{16}$" DIA. COTTER 2" LONG
F	2	KEY STEEL	KEY $1\frac{3}{4}$" x $3\frac{1}{2}$" x $5\frac{1}{2}$"

①
NOTE ÷ SEND AT ONCE TO ELECTRICAL DEPARTMENT OF ALLIS CHALMERS CO., MILWAUKEE, WIS. FOR THEIR ORDER 2-E-4136. A TEMPLATE FOR THE KEYWAYS AND A PIN GAUGE FOR THE BORE. LATER SEND COUPLING TO SAME ADDRESS TO BE SHRUNK ON MOTOR SHAFT.

ALTERATION OF ROD MILL DRIVE
DETAIL OF MOTOR COUPLING

SCALE 3 IN = 1 FT
CONTRACT INTER. I. & ST. CO.
DATE 1-12-18
DR. A.R.K. CH. A.R.K.
TR. H.F.K. APP.

REVISED			
1	3-4-18	6	
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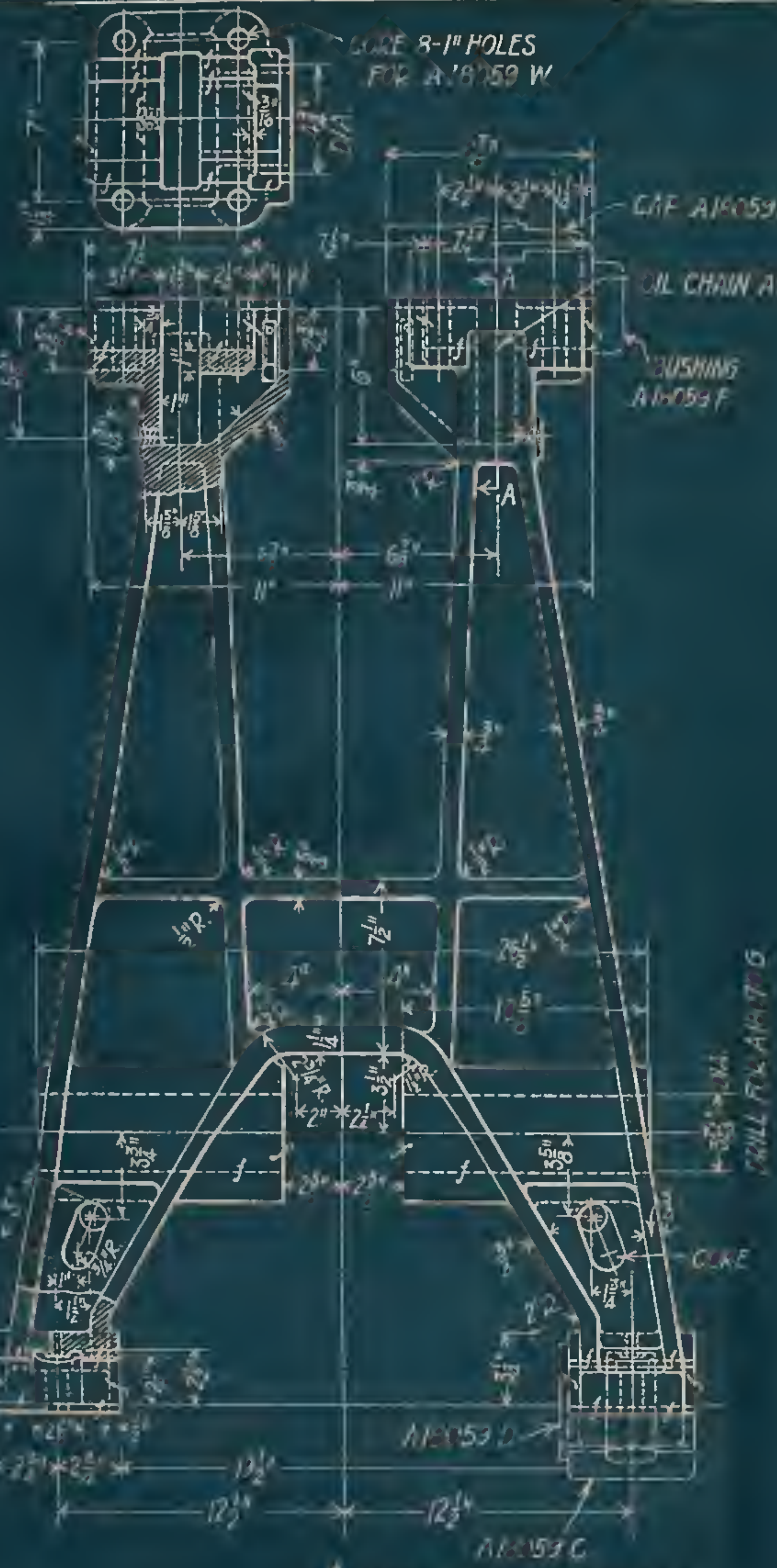
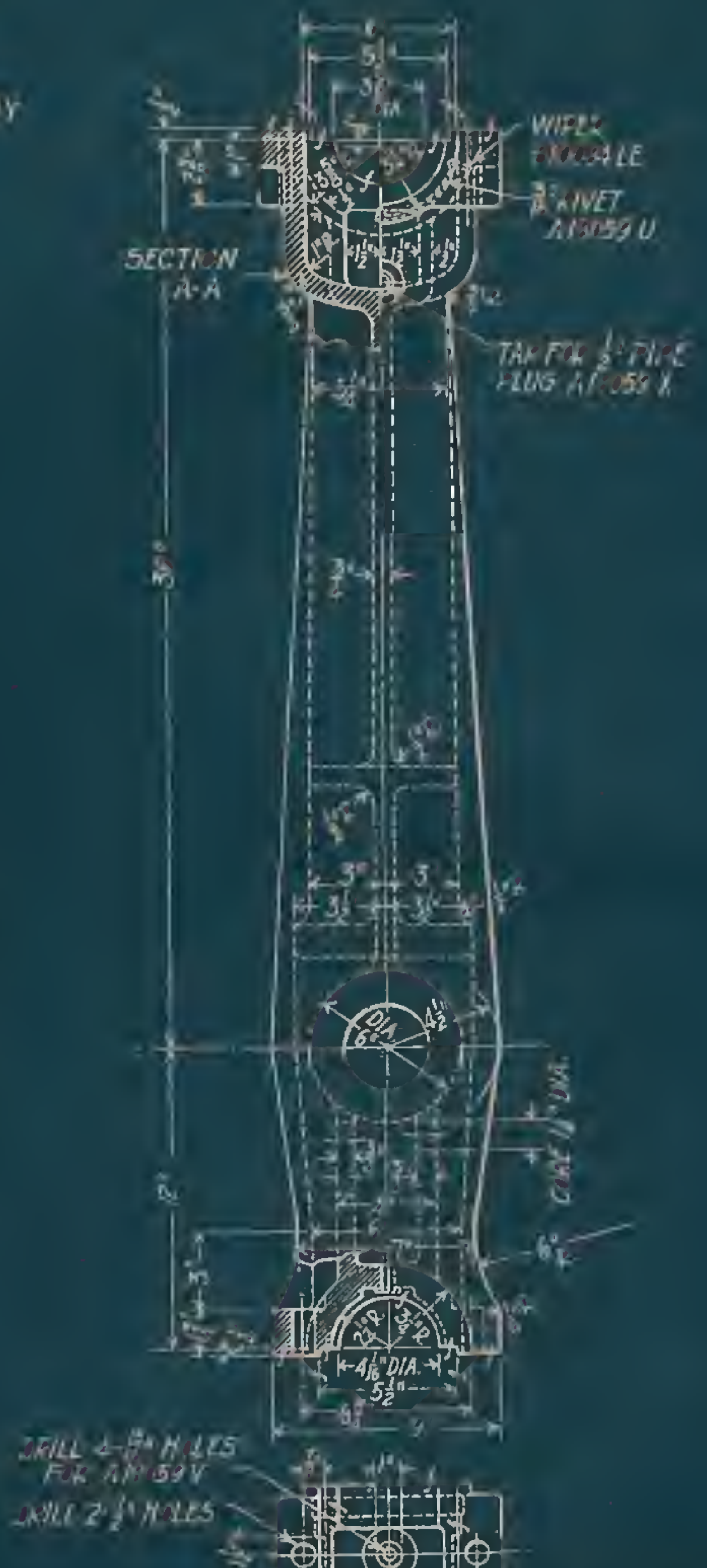
FROM
MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

B 22850



A ALTER PATTERN A18053 B



FOR ONE HOT BED

BILL OF MATERIAL			
MARK	NO. REQ'D	STOCK	DESCRIPTION
A	4	ST. CSTG.	BINDER ARM
A18059 A	4	C.I.	BASE
A18059 C	8	ST. CSTG.	CAP
A18059 D	8	LUMEN BRONZE	BUSHING
A18059 E	8	C.I.	CAP
A18059 F	8	LUMEN BRONZE	BUSHING
A18059 G	8	ST. CSTG.	SPRING SEAT
A18059 H	12	ST. CSTG	SPRING SEAT
A18059 J	8	ST. CSTG.	SPRING SEAT
A18059 K	16	SPR. ST.	SPRING
A18059 L	4	SPR. ST.	SPRING
A18059 M	16	SPR. ST.	SPRING
A18059 N	4	C.R. ST.	PIN 3 7/16" DIA. X 30 3/4" LG.
A18059 U	8	STEEL	RIVET 3/16" X 3/4" LG.
A18059 V	16	BAR ST.	BOLT 7/8"x4 1/2" & LOCK WASHERS
A18059 W	32	BAR ST.	BOLT 7/8"x6 1/4" & LOCK WASHERS
A18059 X	8	C.I.	1/2" PIPE PLUG
A18059 Y	8	TINNED ST.	UNIVERSAL CHAIN 5/16" X 18 1/2"
A18059 Z	4	BAR ST.	SET SCREW 3/4" x 2 1/4"
B10084 GA	8	C.I.	OIL COVER
B10084 HA	8	SP. BRASS	SPRING
B10084 KA	8	STEEL	RIVET 1/2" X 1 3/4"
B10084 LE	8	SP. BRASS	WIPER
A18070 B	4	ST. CSTG.	SHEAVE
A18070 D	4	ST. 20% C	SHAFT
A18070 E	4	BAR ST.	SPRING ROD
A18070 F	4	BAR ST.	SPRING ROD
A18070 G	4	C.R. STEEL	PIN
A18070 H	4	C.R. STEEL	PIN
A18070 J	4	C.R. STEEL	PIN
A18070 M	4	STEEL	COTTER 5/8" X 5"
A18070 N	16	STEEL	COTTER 1/4" X 1 1/2"

21" SHEET BAR & SLAB MILL
COOLING BEDS
BINDER ARM FOR ROPE TAKE-UP

SCALE 3" = 1'
CONTRACT 3960 N.S.W. CT.
DATE 4-22-16
DR J. McM CH Z.W.L.
TR [illegible] W. APP [illegible]

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FROM
MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

B 23188

XXVIII

PLATE XXVIII

BINDER ARM FOR ROPE TAKE-UP

The title plate shows that the views in Plate XXVIII are of a binder arm for rope take-up used on the cooling beds of a 21-inch sheet bar and slab mill. A long bill of materials is given. The title also tells us that in the original blueprint the views are drawn to a scale of 3 inches to 1 foot.

The views are complete and this is a very interesting blueprint for either a pattern maker or a machinist. For example, the reader will note that at the right-hand upper part of the front view the bearing cap is shown in place on its bearing by a series of dash and dot lines known as *broken lines.* This gives a sort of *skeleton* view of the cap. At the same place is a skeleton view of a bushing marked *A18059F.* Looking this number up in the bill of materials, the reader finds that the bushing is made of lumen bronze and that eight are required for four binder arms. Directly below this part of the view and at its extreme lower edge, similar skeleton views are shown of a cap *A18059C* and a bushing *A18059D.* In looking for these numbers in the bill of materials, the reader finds the names of the parts, the material used, and the number required for four binder arms. When the reader has carefully located each part in the bill of materials, he should consider its name, the number required, and the material used. The bill of materials shows that the binder arm is marked *A,* that it is made from a steel casting, and that four are required.

Another interesting matter relating to this blueprint is the method used in sectioning various parts of the views to open up the bearings clearly to the reader. A bottom view of the lower bearing is shown placed just below the side view and a similar top view of the upper bearing is placed just above the left side of the front view. The machinist must finish the four bearings to fit the caps and the lumen bronze bushings and drill a pin hole $3\frac{29}{64}$ inches in diameter for *A18070G* through the length of two circular hubs plainly showing in the lower half of the front and the side views. In addition, he must drill a $\frac{1}{2}$-inch oil hole in the upper part of the lower bearing and a hole just below each of the upper bearing and tap for a $\frac{1}{2}$-inch pipe plug. The machinist will also note that both ends of all four bearings and the inner ends of the pin hubs are finished and that a spring brass wiper is riveted into each of the upper boxes near its inner end.

The pattern maker will note that the framework of the piece is a simple rib construction for supporting the several bearings and hubs and that the working lines are well dimensioned.

The upper bearings are complicated by having to be cored for an oil well, or chamber. The oil in this chamber is distributed to the shaft by means of a tinned steel universal chain *A18059Y* hung on the shaft into the enlarged part of the center of the oil chamber. The pattern maker should also note the special cored holes through the outer and the inner ribs showing just below the long pin hubs. Finish *f* marks placed across certain working lines of the view show the pattern maker for which surfaces he must allow an excess of metal for the machinist's needs. The bolt holes in the upper bearings for *A18059W* are cored, while those in the lower bearings for *A18059V* are drilled by the machinist.

PLATE XXIX

PARTS OF SHUTTLE MECHANISM FOR LOOM

Plates XXIX, XXX, and XXXI are each made up of four small blueprints originally $4\frac{1}{2}'' \times 5\frac{1}{2}''$ and show the practice of the Crompton-Knowles Loom Company. The small $4\frac{1}{2}'' \times 5\frac{1}{2}''$ blueprints are those used in their shops as working blueprints. Each small blueprint is from a *free-hand* sketch of some part of one of their machines and contains all that the workman needs to know when machining the piece. Blueprints made like those which we have been studying are used by the pattern maker.

A number placed in a circle has been added to each small blueprint to make it easy to refer to and each is provided with a title plate which contains certain information useful to the workman. For example, the title plate of the small blueprint No. 1 tells us that the piece is a rocker iron for a shuttle change motion on a medium duck loom and that the material is cast iron. Blueprint No. 2 shows the lower part of a shuttle carrier; No. 3, a stand for a lifter; and No. 4, the top part of a shuttle carrier. In many of these blueprints no over-all dimensions are given, and as they are not made to any particular scale of sizes, in such cases the sketch artist places the over-all length of the piece in the upper

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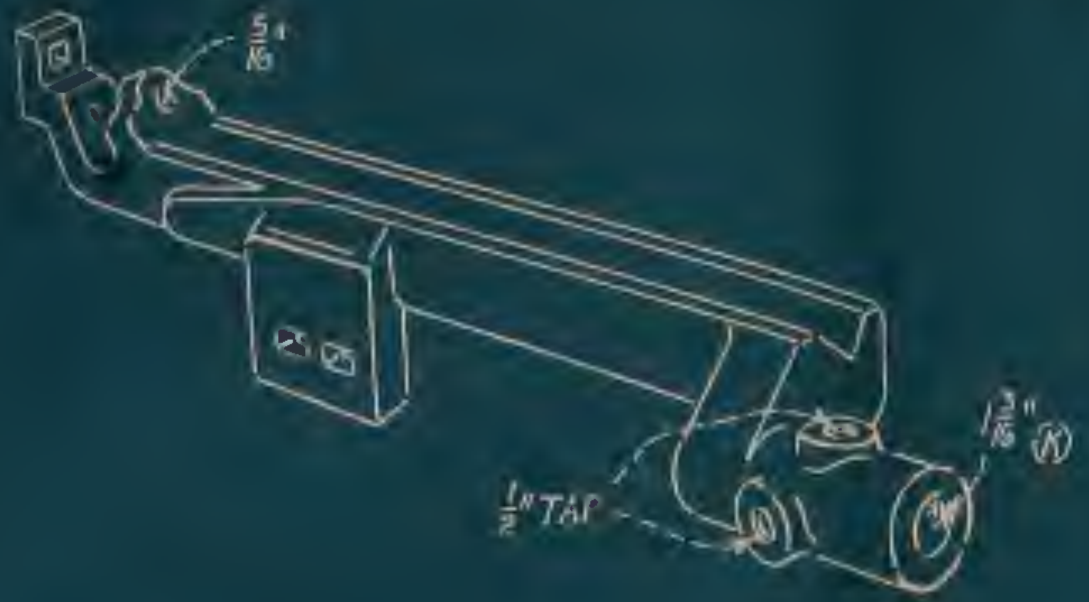
NO. 108152-3 ①

21"

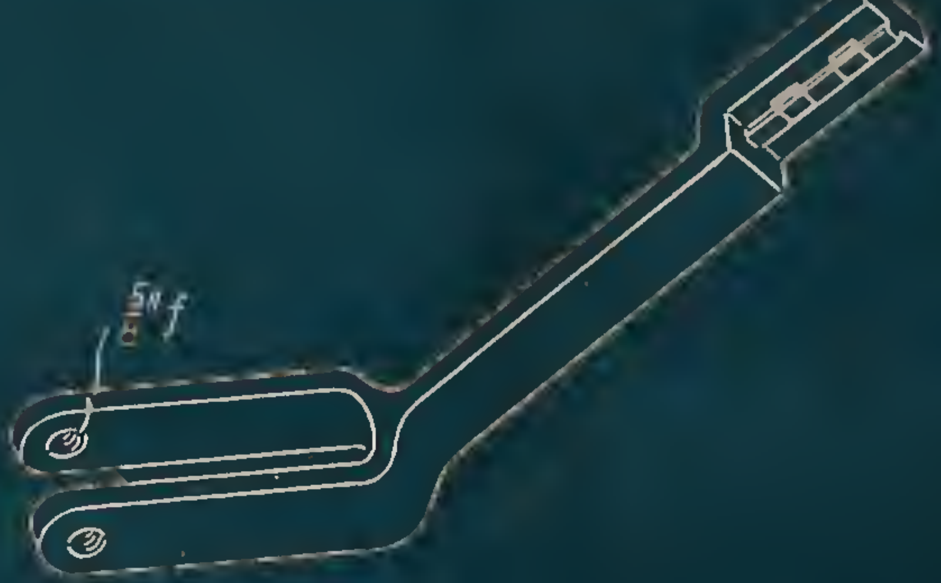


TITLE ROCKER IRON
MOTION SHUTTLE CHANGE (LAY)
FOR DETAIL SEE

LOOM MED. DUCK
MATERIAL C.I.
DATE 4-10-18

NO. 108158-9 ②

17

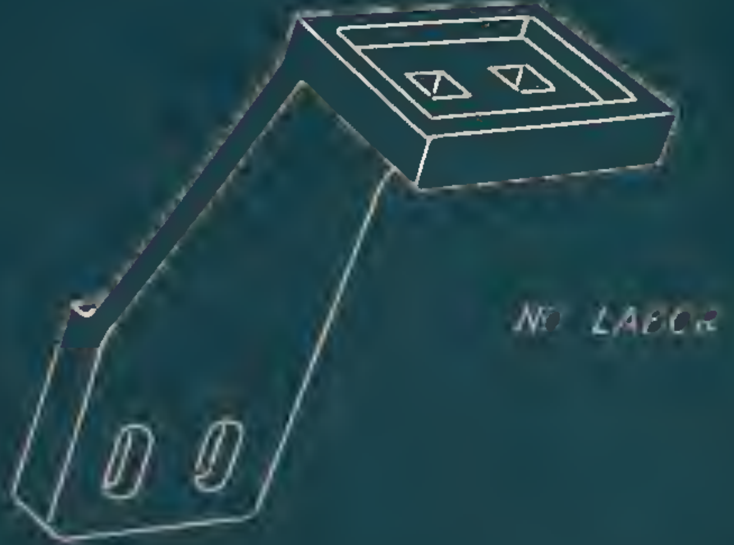


TITLE SHUTTLE CARRIER LOWER PART
MOTION SHUTTLE CHANGER
FOR DETAIL SEE

LOOM MED. DUCK
MATERIAL C.I.
DATE 4-12-18

NO. 108154-5 ③

9"



NO LABOR

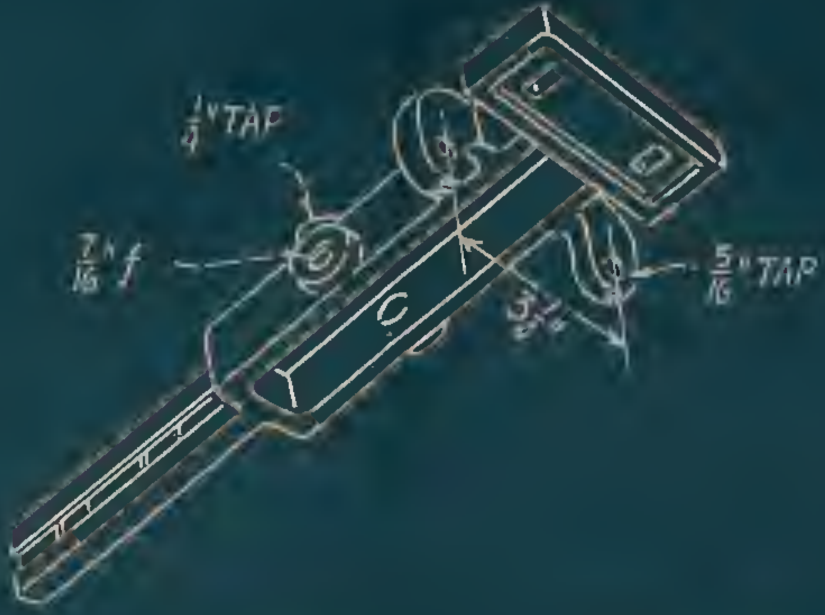
TITLE STAND FOR LIFTER ROD GUIDE
MOTION SHUTTLE CHANGE
FOR DETAIL SEE

XXIX

LOOM MED. DUCK
MATERIAL C.I.
DATE 4-10-18

NO. 108156-7 ④

15



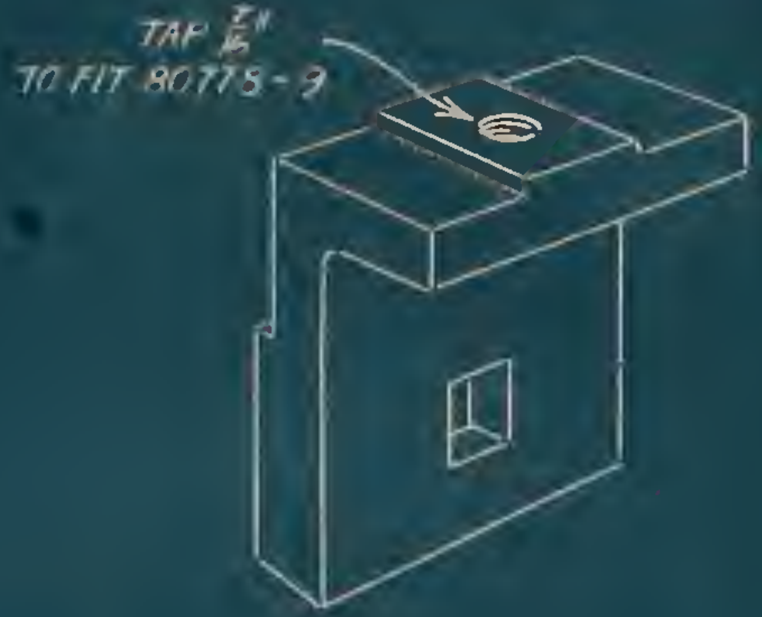
TITLE SHUTTLE CARRIER TOP PART
MOTION SHUTTLE CHANGER
FOR DETAIL SEE

LOOM. MED. DUCK
MATERIAL C.I.
DATE 4-12-18

NO. 108829

$5\frac{1}{4}''$

①



TITLE STAND FOR GEAR GUARD
MOTION CAM HAR. MO.
FOR DETAIL SEE

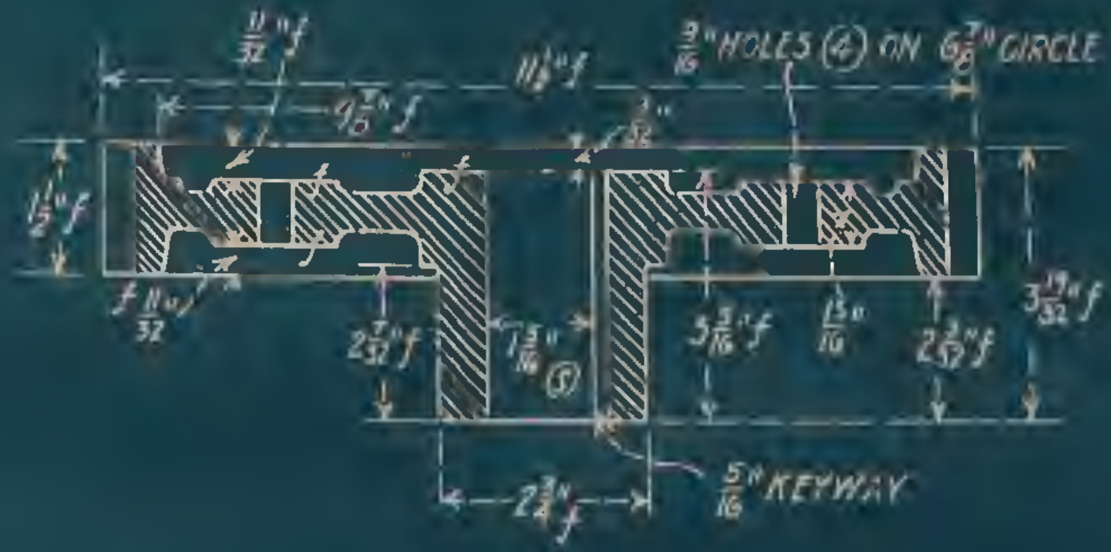
LOOM WEBBING
MATERIAL C.I.
DATE 6-15-18

NO. 108827

$11\frac{1}{2}''$

CUT TEETH $\frac{44\ T.}{4\ P.}$

②



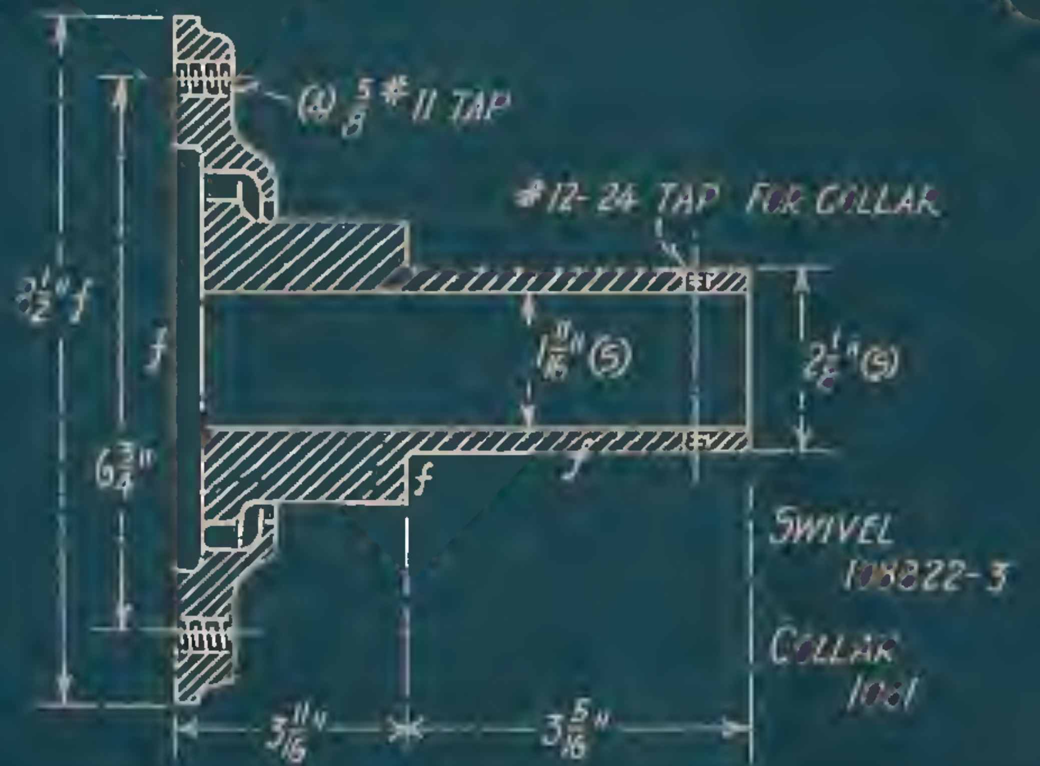
TITLE SPUR GEAR ON CRANK SHAFT
MOTION DRIVE
FOR DETAIL SEE

LOOM SILK
MATERIAL C.I.
DATE 6-18-18

NO. 108824

$8\frac{1}{2}''$

③



TITLE HUB FOR PULLEY
MOTION DRIVE
FOR DETAIL SEE

XXX

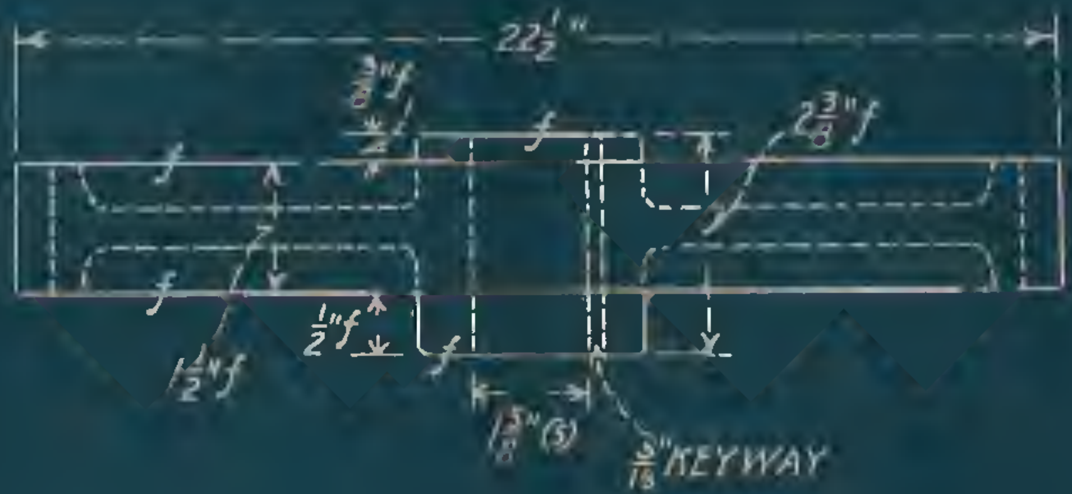
LOOM PRESS CLOTH
MATERIAL C.I.
DATE 6-25-18

NO. 108826

$22\frac{1}{2}''$

CUT TEETH $\frac{88\ T.}{4\ P.}$

④



TITLE SPUR GEAR ON BOTTOM SHAFT
MOTION DRIVE
FOR DETAIL SEE

LOOM SILK
MATERIAL C.I.
DATE 6-18-18

left-hand corner in small numerals over or on a short line; for example, the piece in blueprint No. 1 is 21 inches long. While this dimension is of no value to the machinist, it does aid the stores keeper in handling the castings, for, while each sketch is a picture of the piece in so far as its outlines are concerned, unless the small numerals are read, there is nothing in the view to indicate whether the piece is inches or feet in length. While such working blueprints are not commonly used, it is worth the reader's while to study them, as they show very clearly the use of free-hand sketches.

It must be borne in mind that in certain lines of machine building, while a given machine may consist of a great many parts, each part may be a very simple piece requiring but little or no machining; for example, blueprint No. 1 shows a piece of work that is to have four drilled holes, two of which are tapped; No. 2 shows a piece with one drilled hole; No. 3 is marked "no labor" and shows a piece of work in which the holes are made in the foundry by the use of properly shaped cores; and No. 4 is a little more complicated, having two $\frac{5}{16}$-inch tapped holes $3\frac{1}{4}$ inches apart and one $\frac{1}{4}$-inch tapped hole with the end of the hole boss, faced.

PLATE XXX

DETAILS OF GEARED MECHANISM USED ON CROMPTON-KNOWLES LOOM

In Plate XXX, blueprint No. 1, which represents a stand for a gear guard, is shown in the same manner as the blueprints in Plate XXIX. When pieces are sketched in this way, they are said to be shown in *perspective;* they are also termed picture sketches, as they are shown tipped and swung around from the regular squarely viewed position of the ordinary blueprint. Blueprints Nos. 2, 3, and 4, Plate XXX, representing a spur gear on the crankshaft, a hub for a pulley, and a spur gear on the bottom shaft, respectively, are shown viewed squarely from the front, and the real difference between them and most of the blueprints which we have studied lies in their being made by free-hand pen methods rather than by the use of drawing instruments. An end view of blueprint No. 2, 3, or 4 would show a series of concentric circles. Finish *f* marks indicate the working surfaces which are to be finished by some method of machining.

In Nos. 2 and 4 two dotted working lines and a lettered note tell us that a $\frac{5}{16}$-inch keyway is to be machined in the surface of the holes through the central hubs of these gears. In the case of No. 2, a lettered note states that four $\frac{9}{16}$-inch holes on a $6\frac{7}{8}$-inch circle are to be drilled through the web of the gear, and the sketch shows that these are placed in slightly raised hubs, or bosses. It will be noted by the careful reader that, while in most instances the finish *f* marks are placed in the usual manner on the working lines of the views, in some cases they are given with the dimension figures. As a case in point, take the diameter of the longer hub in No. 2. Here the finish *f* mark follows the dimension figures thus, $2\frac{3}{4}''$ *f*. Several similar cases will be noted in these sketches by the interested reader. While most machine gears have "cut" teeth, this is not universally so on certain lines of machinery and lettered notes at the top of No. 2 and No. 4 state that these gears have "cut" teeth.

PLATE XXXI

MISCELLANEOUS MECHANISMS USED ON CROMPTON-KNOWLES LOOMS

Plate XXXI, like the two preceding plates, is made up of four blueprints originally $4\frac{1}{2}'' \times 5\frac{1}{2}''$. Reading the title plate, we learn what each piece is and the material used. Blueprints Nos. 1, 2, and 4 show, respectively, a stand for a shipper and lock lever, an angle iron post, and a guide for a lifter rod, and they are picture, or perspective, views. No. 3 is the ordinary type of freehand sketch and shows a front and an end view of a ratchet and pinion. While no special directions are needed in reading, attention is called in No. 1 to the $\frac{5}{8}$-inch hole near the lower part of the piece. While this shows the stud *#4757* in place, the stud is evidently a separate piece. In No. 2, the long shank has no finish *f* marks but is marked $\frac{3}{4}''$ *f*. In No. 3 two views are necessary to show that one set of teeth is on a slender hub.

PLATE XXXII

BRASS CHECK VALVE

First-Angle Projection. While "Mechanical Drawing," Parts I, II, and III, does not analyze in detail the method of projection

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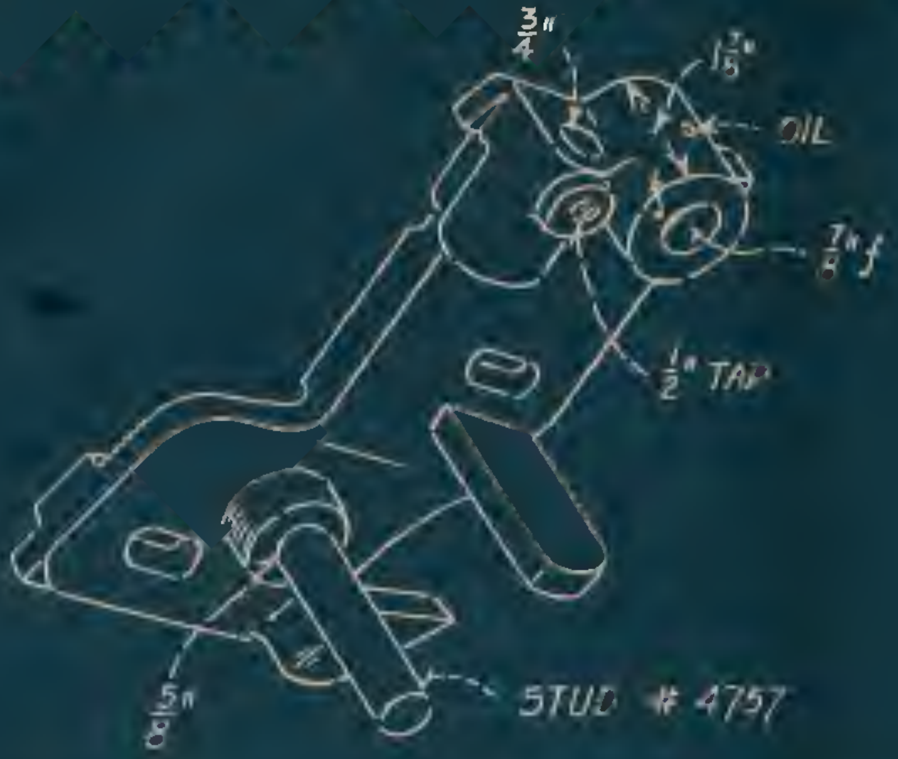
NO. 108174-5

①

$9\frac{1}{2}$"



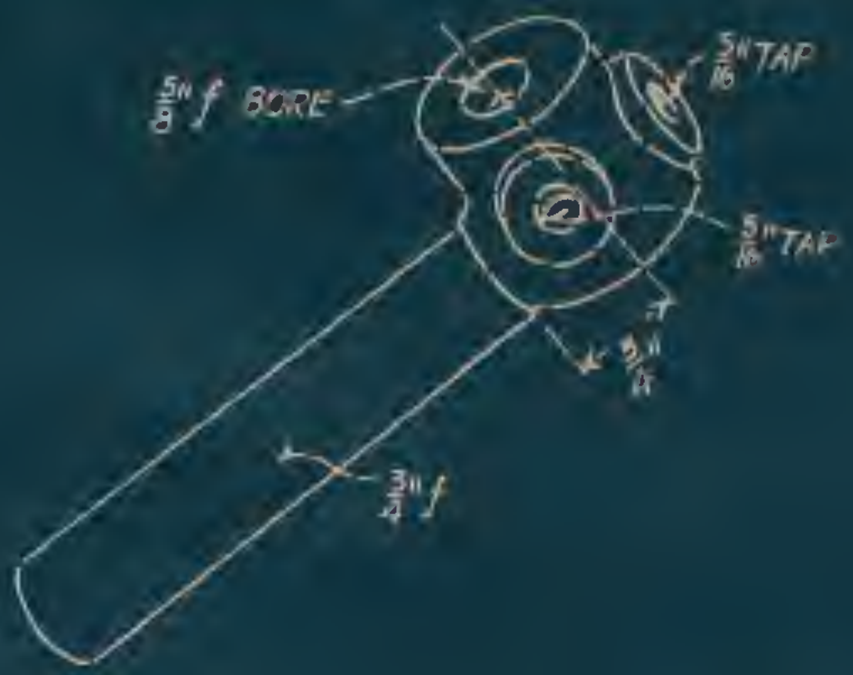
TITLE STAND FOR SHIPPER & LOCK LEVER
MOTION DRIVE
FOR DETAIL SEE

LOOM TIRE FABRIC
MATERIAL C.I.
DATE 4-15-18

NO. 108178

②

$5\frac{1}{2}$"



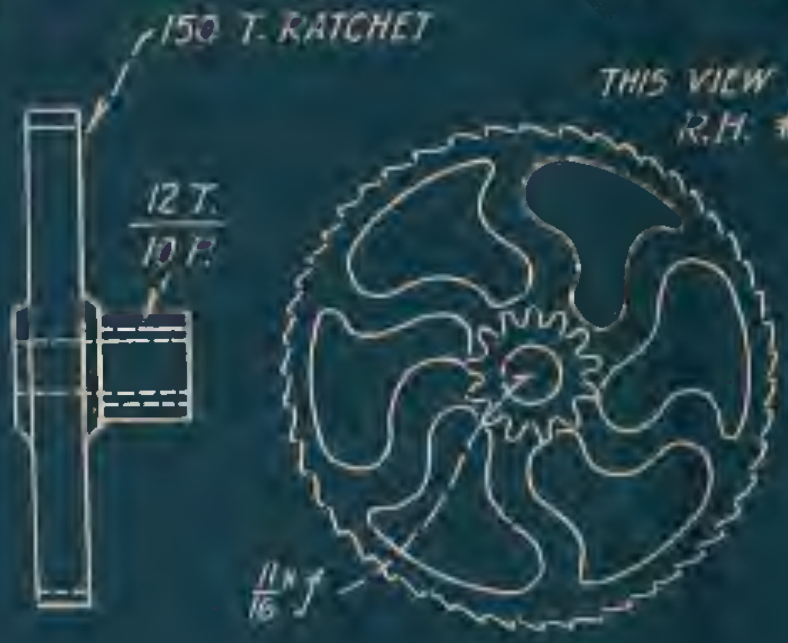
TITLE ANGLE IRON POST
MOTION WARP STOP
FOR DETAIL SEE

LOOM PROV. COTTON
MATERIAL C.I.
DATE 4-15-18

NO. 108176-7

③

7"



THIS VIEW SHOWS
R.H. #108176

TITLE RATCHET & PINION
MOTION TAKE UP
FOR DETAIL SEE

XXXI

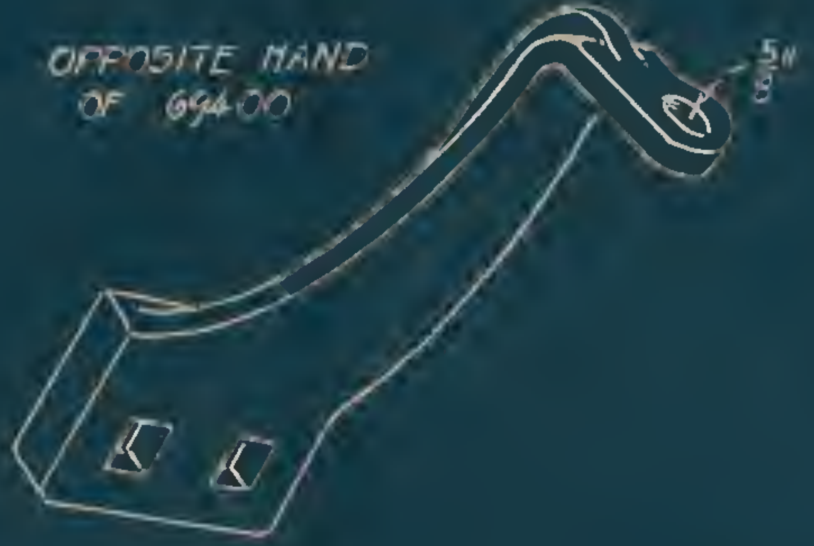
LOOM TAPE
MATERIAL C.I.
DATE 4-16-18

NO. 108179

④

$7\frac{3}{4}$"

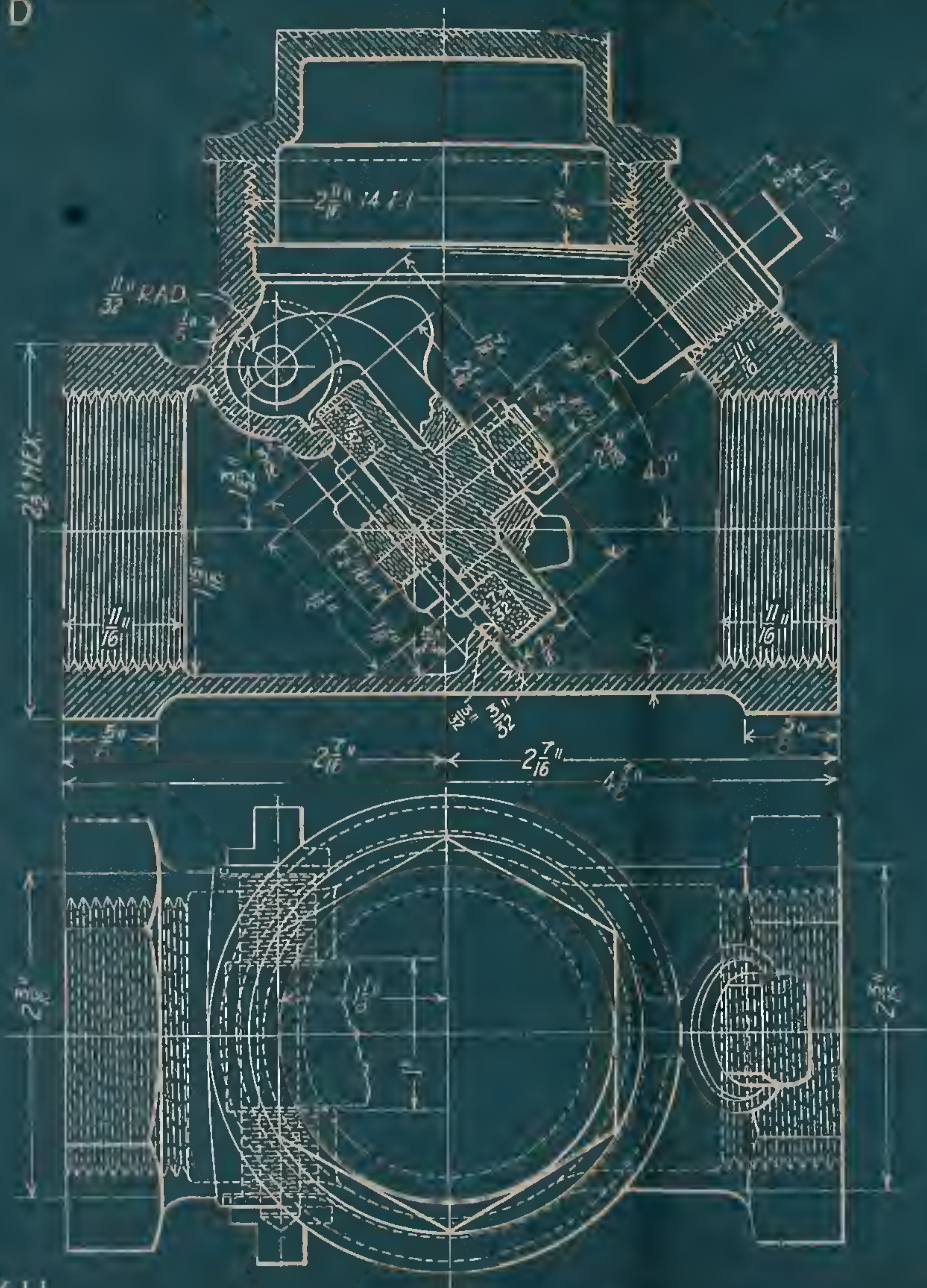
OPPOSITE HAND
OF 69400

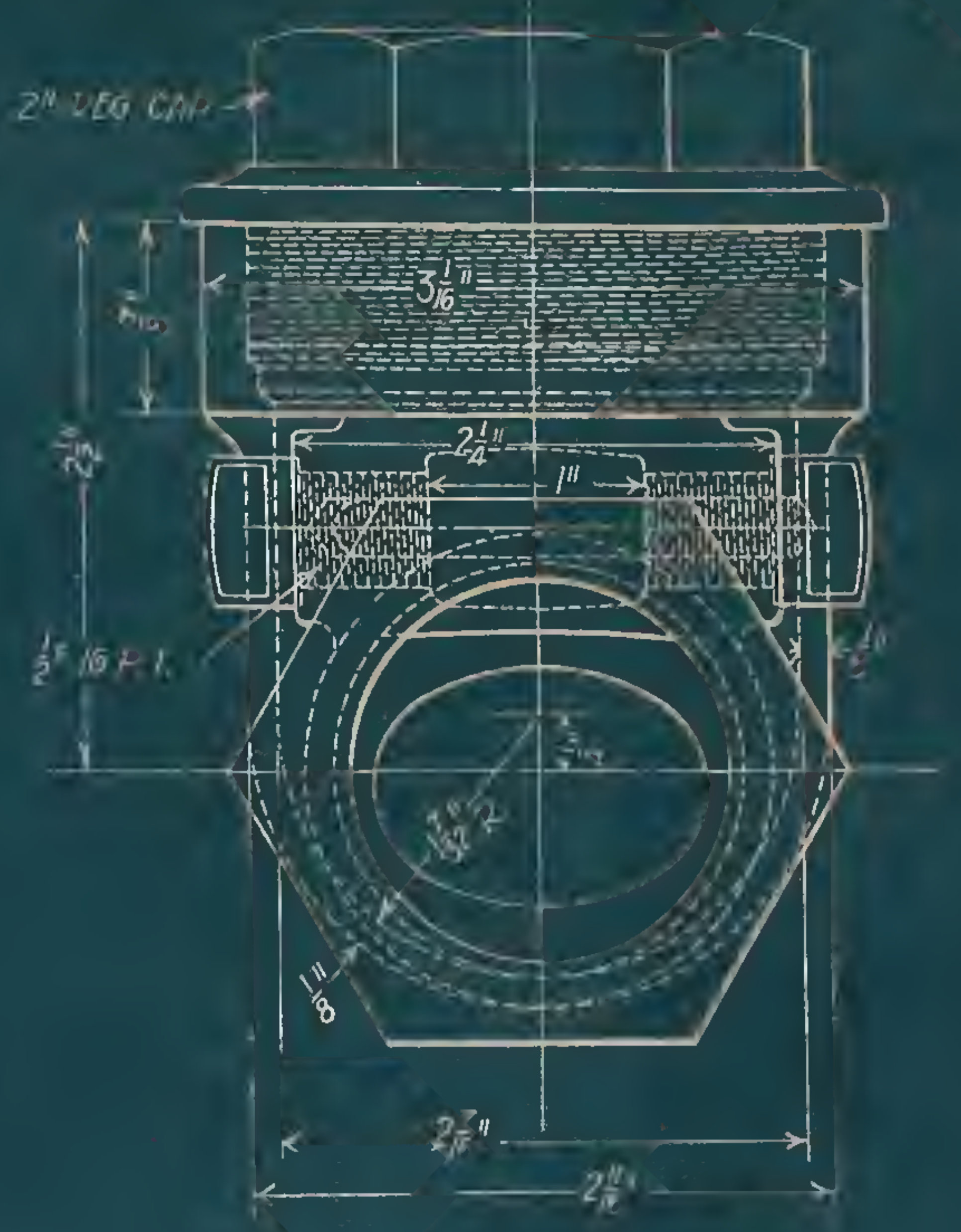


TITLE GUIDE FOR LIFTER ROD
MOTION LAY
FOR DETAIL SEE

LOOM CROMPTON COT. BLANK
MATERIAL C.I.
DATE 4-17-18

3189 D





SCALE
FULL SIZE

$1\frac{1}{2}$ IN BRASS CHECK
FOR LEATHER OR ASBESTOS DISC

DATE
MARCH 30 1905

THE PRATT & CADY CO. INC.
HARTFORD, CONN.

RETRACED
10-6-14
H.J.M.

3189 D

used in Plate XXXII, readers of blueprints often have such placed in their hands. The blueprints of machine parts shown in this text are, with this one exception, drawn in what is known as third-angle projection. In addition to what this book contains on views and their arrangement, "Mechanical Drawing," Part III, defines and illustrates first-angle and third-angle projection and the blueprint reader should study the opening pages of Part III. In Fig. 97, Part III, the reader will note that the lines of the piece viewed are sent forward on a plane surface. In other words, instead of placing the object we are viewing on the far side of some material like plain glass and viewing it through the glass and then making on the glass a sketch of what we see, the object is placed in front of the glass and we make the sketch on the glass as if we sighted along its edges and drew lines on the glass in line with the edges we were sighting. Looking at an object in this manner places the right end view in the blueprint at the left side of the front view instead of at the right side as in previous blueprints, and the surface lines seen in looking down on the top of the object are shown below the front view.

Placing of Views. If this method is clear in the reader's mind, let him return to Plate XXXII. He will observe that the front view of this 1½-inch brass check valve has been placed at the upper left-hand corner of the sheet. Just below the front view and centered with it is the view one would get of this valve if he were viewing it on its top side, or upper surface. By the regular third-angle system of placing views, the top view would be shown above the front view. The end view, as the careful reader will note, represents the view one would get if looking at the left end of the front view. While it is, then, a view of the left end of the valve and would, in ordinary view arrangement, be placed at the left of the front view, it is by the first-angle arrangement of views placed at the right of the front view. In tracing the location of a line from one view to another, the blueprint reader will need to use care if he is not accustomed to this method of showing views.

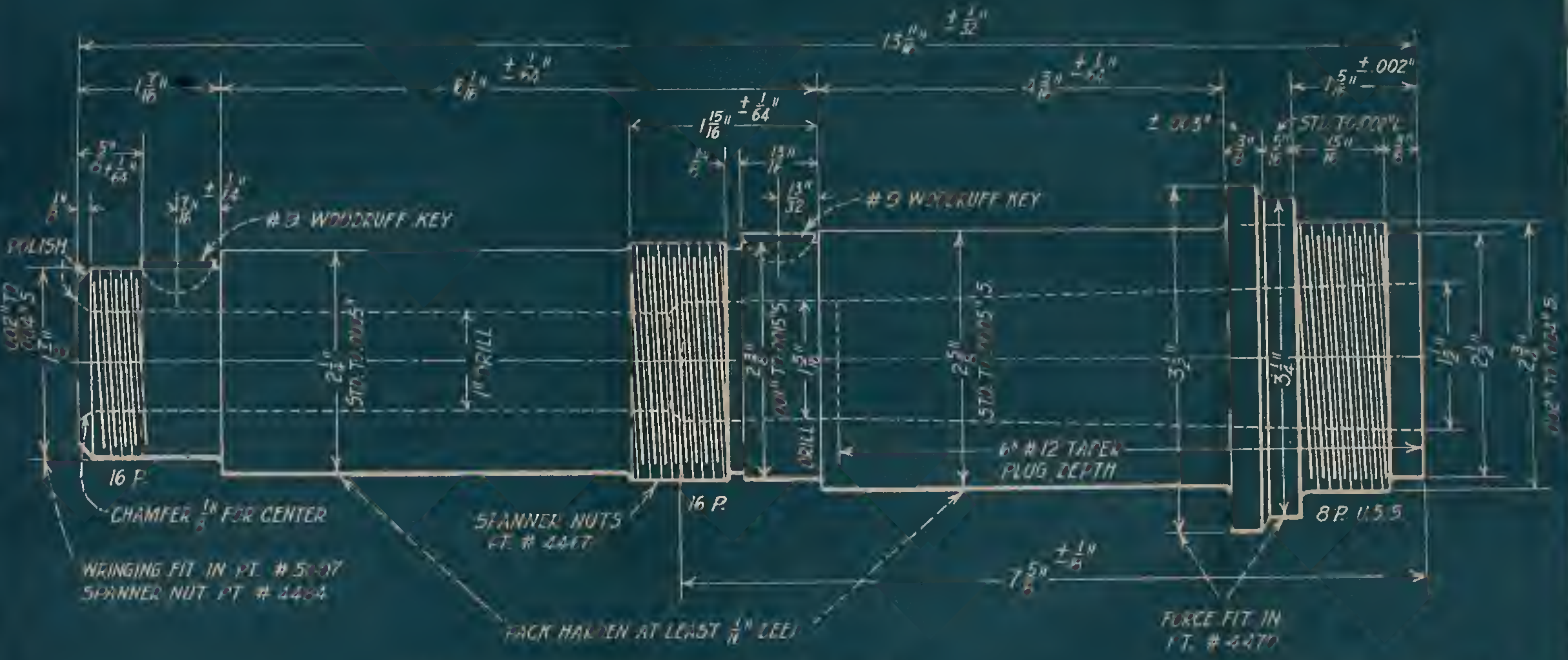
Details of Blueprint. Other than the arrangement of views, this blueprint is easily read, having, as it does, a hollow spherical body with hexagon ends and a circular hole in its upper side, a hexagon cap screwed into the top side hole, and an internal swing hinged valve flapper. A tapped hole in the upper right corner of the body is made at an angle of 40 degrees with the axis of the valve body and into this is screwed a special plug as shown. The flapper is hinged on a small diameter spindle which is centered and held in place by two bearing plugs placed opposite each other in the body of the valve. The flapper consists of a hinged frame, a circular disc having a ring of leather or asbestos in its under side groove, a bolt, a nut, and a washer to hold the ring in the disc groove and the ring and disc onto the hinged frame.

PLATE XXXIII

SPINDLE

When interpreting Plate XXXIII, the reader will note from the title plate that the spindle is made from 15-point machine steel. Fifteen point when used in this manner means that the carbon content in the steel is fifteen-hundredths of one per cent. The shop man and the mill man shorten this by saying or writing it 15 point. A front view only is needed to show all the necessary outlines of the spindle and to give all the necessary dimensions for the workman as an end view would consist of a series of concentric circles except for the keys and their seatings.

Dotted lines centered with the center line of the work and drawn from end to end of the view show a hole through the length of the spindle. A lettered note tells us that in the right-hand, or nose, end of the spindle this hole is No. 12 taper to a plug depth of 6 inches. In producing the hole, the workman would first drill a hole 7$\frac{5}{8}$ inches deep plus or minus $\frac{1}{8}$ inch, using a 1$\frac{3}{16}$-inch drill, and then he would continue the hole completely through the length of the spindle, using a 1-inch drill. A lettered note with an indicating arrowhead informs us that the rear end of the hole is to be chamfered $\frac{1}{8}$ inch for center. Another lettered note states that the spindle bearings are to be pack hardened at least $\frac{1}{16}$ inch deep. A lettered note placed near the nose of the spindle tells us that the 3$\frac{1}{4}$-inch and the 3$\frac{1}{2}$-inch diameters are to be a forced fit in part #4470. Some makers of working blueprints use the term press fit instead of force fit. Either term would indicate that part #4470 is to be pressed onto the spindle at the places indicated by the arrow points. The lettered



WHEN TURNING LEAVE NO FILLET UNLESS CALLED FOR.
WHEN GRINDING LEAVE FILLET MADE BY WHEEL NOT TO
EXCEED 1/32" RADIUS UNLESS OTHERWISE CALLED FOR.

DO NOT THREAD UNTIL AFTER
HARDENING & GRINDING
ON DIAMETERS

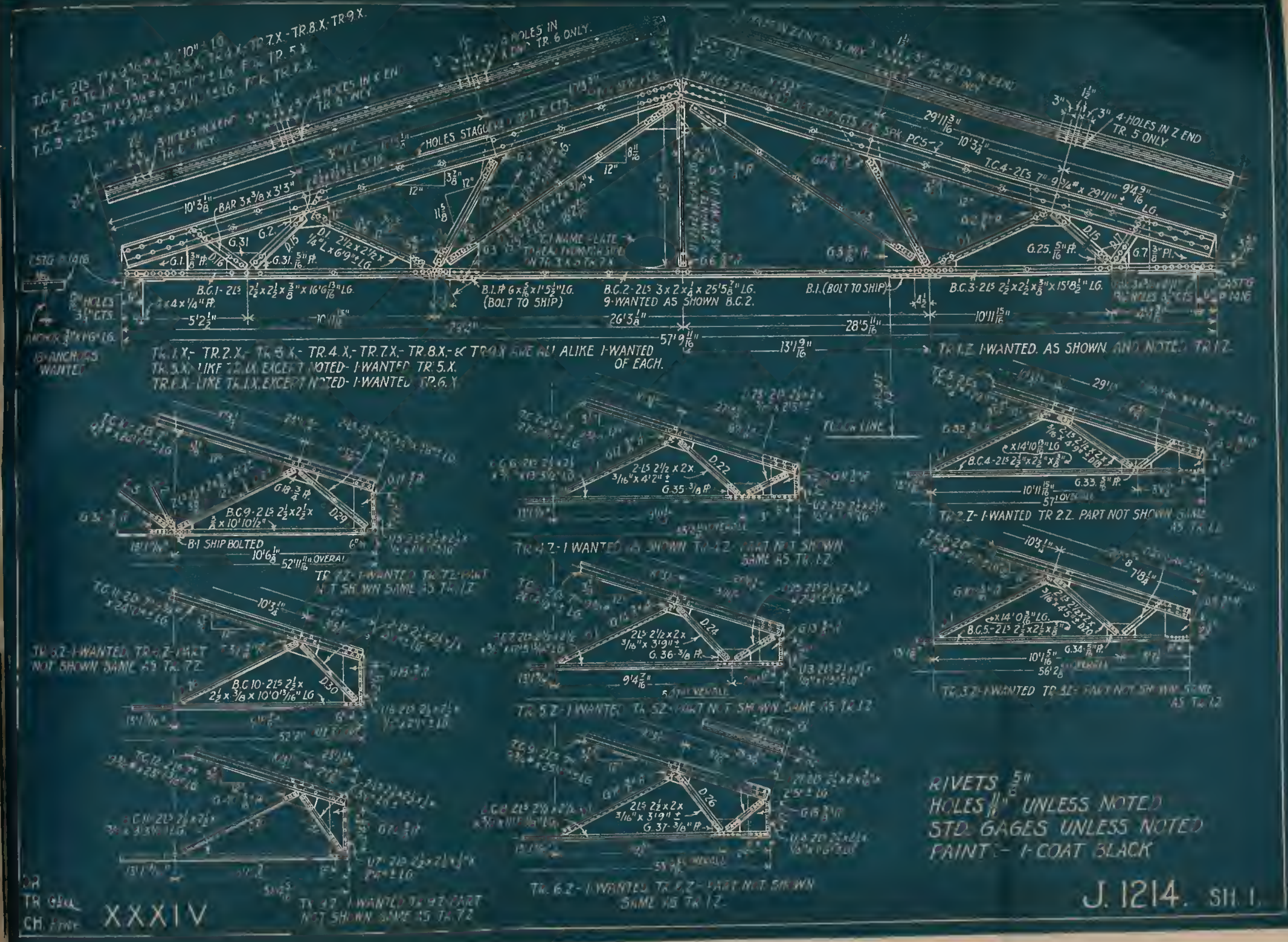
4-9-18 8-25-15	
DATE CHANGED	
5018	15 PT. MACHINE STEEL SCALE FULL SIZE

XXXIII

Unless Otherwise Specified, Limits On This Drawing Are ±.005"
Dimensions Of Angles ± 1°. Reamed And Bored Holes Std To .001" Small.

DRAWN BY G.M.D./J. CHECKED BY A.G.B./B. APPROVED BY W.H.B.OT DATE 4-9-18	NAME SPINDLE FOR JOB - 10" L.S.A.

NORTON GRINDING CO., WORCESTER MASS., USA


T.C.1- 2L5 7" x 9 3/4# x 30'10" ± LG. FOR TR.1.X.- TR.2.X.- TR.3.X.- TR.4.X.- TR.7.X.- TR.8.X.- TR.9.X.
T.C.2- 2L5 7" x 9 3/4# x 30'11" ± LG. FOR TR.5.X.
T.C.3- 2L5 7" x 9 3/4# x 30'11" ± LG. FOR TR.6.X.
4-HOLES IN X END TR.6 ONLY.
HOLES STAGGERED
BAR 3 x 3/8 x 3'3"
10'3 1/8"
12"
3 7/8"
11 5/8
8 11/16
G.1. 3/8" PL.
G.2.
G.31
G.31. 5/16" PL.
D.15
D.16
D.1. 2 1/2 x 2 1/2 x 1/4" L x 6'9" ± LG.
G.3.
T.1 NAME PLATE
G.6
G.5
CSTG P.1416
HOLES 3 1/4" CTS.
4 x 4 x 1/4" PL.
ANCHOR 3/4" x 8" LG.
16-ANCHORS WANTED
B.C.1- 2L5 2 1/2 x 2 1/2 x 3/8" x 16'6 13/16" LG.
B.I. PL 6 x 5/16 x 1'5 1/2" LG. (BOLT TO SHIP)
B.C.2- 2L5 3 x 2 x 1/4 x 25'5 7/8" LG. 9-WANTED AS SHOWN B.C.2.
B.I. (BOLT TO SHIP)
B.C.3- 2L5 2 1/2 x 2 1/2 x 3/8" x 15'8 1/2" LG.
5'2 1/2"
10'11 15/16"
26'3 1/8"
28'5 11/16"
57'9 11/16"
13'1 9/16"
4 1/2
10'11 15/16"
CAST'G P.1416
4-HOLES IN Z END TR.5 ONLY.
29'11 3/16"
10'3 3/4"
T.C.4- 2L5 7" 9 3/4# x 29'11" ± LG.
9'4 9/16"
3"
1 1/2"
G.25. 5/16" PL.
G.7. 3/8" PL.
G.3. 3/8" PL.
D.15
TR.1.X.- TR.2.X.- TR.3.X.- TR.4.X.- TR.7.X.- TR.8.X.- & TR.9.X. ARE ALL ALIKE 1-WANTED OF EACH.
TR.5.X.- LIKE TR.1.X. EXCEPT NOTED- 1-WANTED TR.5.X.
TR.6.X.- LIKE TR.1.X. EXCEPT NOTED- 1-WANTED TR.6.X.
TR.1.Z. 1-WANTED. AS SHOWN AND NOTED TR.1.Z.
TOUCH LINE
G.18. 3/4" PL.
B.C.9- 2L5 2 1/2 x 2 1/2 x 3/8 x 10'10 1/2"
D.29
B.I. SHIP BOLTED
10'6 1/8"
52'11 11/16" OVERALL
TR.7.Z.- 1-WANTED TR.7.Z. PART NOT SHOWN SAME AS TR.1.Z.
2-L5 2 1/2 x 2 x 3/16" x 4'2" ±
D.22
G.35- 3/8 PL.
TR.4.Z.- 1 WANTED AS SHOWN TR.4.Z. PART NOT SHOWN SAME AS TR.1.Z.
29'1"
G.32
x 14'10 13/16" LG.
B.C.4- 2L5 2 1/2" x 2 1/2" x 3/8"
2L5 2 1/2 x 2 x 3/16 x 4'9" ±
D.18
G.33. 5/16" PL.
10'11 15/16"
57' OVERALL
TR.2.Z.- 1-WANTED TR.2.Z. PART NOT SHOWN SAME AS TR.1.Z.
10'3 1/4"
B.C.10- 2L5 2 1/2 x 2 1/2 x 3/8 x 10'0 13/16" LG.
D.30
TR.8.Z.- 1-WANTED TR.8.Z.- PART NOT SHOWN SAME AS TR.7.Z.
2L5 2 1/2 x 2 x 3/16" x 3'9" ±
D.24
G.36- 3/8 PL.
9'4 7/16"
TR.5.Z.- 1 WANTED TR.5.Z.- PART NOT SHOWN SAME AS TR.1.Z.
7'8 1/4"
x 14'0 3/16" LG.
B.C.5.- 2L5 2 1/2 x 2 1/2 x 3/8"
2L5 2 1/2 x 2 x 3/16 x 4'5" ±
D.20
10'1 5/16"
G.34. 5/16" PL.
56'2 1/8" OVERALL
TR.3.Z.- 1-WANTED TR.3.Z.- PART NOT SHOWN SAME AS TR.1.Z.
2L5 2 1/2 x 2 x 3/16" x 3'9" ±
D.26
G.37- 3/8" PL.
TR.6.Z.- 1-WANTED TR.6.Z.- PART NOT SHOWN SAME AS TR.1.Z.
TR.9.Z.- 1-WANTED TR.9.Z.- PART NOT SHOWN SAME AS TR.7.Z.
RIVETS 5/8"
HOLES 11/16" UNLESS NOTED
STD. GAGES UNLESS NOTED
PAINT :- 1-COAT BLACK
J. 1214. SH. 1.
DR
TR
CH.
XXXIV

note placed at the left end of the spindle refers to a wringing fit. A wringing fit is one in which the parts are so fitted in dimensions as to have to be wrung, or twisted, together; some workmen interpret this to mean a fitting so snug that the pieces go together by lightly rapping them. In any case, it means a fit so snug that a little forcing is needed to slip the pieces together. The reader's attention is called to the limiting tolerances as expressed by the plus and minus signs and to the printed directions placed at the lower edge of the sheet which state that "unless otherwise specified, limits on this drawing are ±0.005″; dimensions of angles ±1°; and reamed or bored holes standard to 0.001″ small". The term Woodruff key refers to the Whitney system of using Woodruff keys.

PLATE XXXIV

ROOF TRUSS

Plates XXXIV and XXXV are shown for the reason that the average shop man may be at times called upon to use such. Plate XXXIV shows a piece of structural work known as a roof truss. The word "truss" is shortened to *Tr.* on the blueprint. Steel structural work such as trusses, beams, girders, and columns is usually made up of angles, I beams, channels, plates, etc., riveted in such a manner as to get the desired construction. The various angles, channels, etc., are known as shapes and are hot rolled at the steel mills, straightened, and sold in open market.

The truss shown in Plate XXXIV is built up of angles of varying lengths riveted together and to flat pieces of plate known as gussets, or sometimes gusset plates. The several pieces of angles are given a letter symbol. In the roof truss shown the short pieces of angle steel used to tie the upper and lower parts together are symbolized by *D* and show on the blueprint as *D–1*, *D–2*, etc. The gusset plates are symbolized by *G* and appear on the blueprint as *G–1*, *G–2*, etc. In many cases a truss is too long to ship complete and has to be partly completed at the place used, or, as it is termed, in the field, and rivets driven after the truss leaves the shop are known as field rivets. The rivets which are to be driven while the truss is being built in the shop are indicated in the blueprint by small full circles, while the position of field rivets is shown on the angles by small white circular spots.

Noting what has been said relative to riveting, it will be observed that the blueprint shows that this truss is to be shipped in three sections and field riveted at the place where it is to be used.

A steel angle as rolled has the form shown in Fig. 2. The upright and the horizontal parts are known as the legs of the angle. In the truss shown, two of these angles about 30 feet 10 inches long are placed back to back to form the left half of the upper slant of the truss. In the same manner, two angles about 29 feet $11\frac{3}{16}$ inches long are placed back to back to form the right upper half of the truss. Previous to riveting the angles together for making each top slant, gusset plates as shown at *G–1*, *G–2*, *G–4*, *G–5*, and *G–7* are slipped between the angles and the whole is riveted together. In a like manner, the lower chord of the truss is riveted up. It will be noted that the gusset plates *G* are trimmed to come flush at the outer surfaces of the truss, but that they project into the inside of the truss a distance sufficient to allow the several short angles to be riveted to them. It will also be observed that when the angles are riveted together back to back with gusset plates, the surfaces of the legs of the angles are separated by an amount equal to the thickness of the gusset *G*. Any rivets driven through the angle plates at space points held apart by the gussets have small washers slipped into the crack, or space, between the angles, and the rivets are then set up through the washer. This is shown on the blueprint by means of a dotted circle around the space rivets. It must be noted that the bottom chord of the truss is not made up of single-length angles but is spliced at points about 15 feet $4\frac{1}{8}$ inches from each end of the truss. Where a splice such as this occurs in the bottom chord of a truss, it is strengthened by riveting a splice plate onto the bottom of the angles, covering and tying the splice.

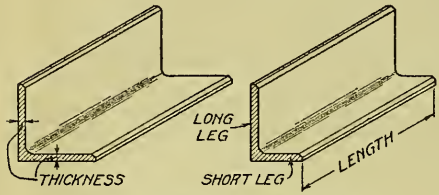
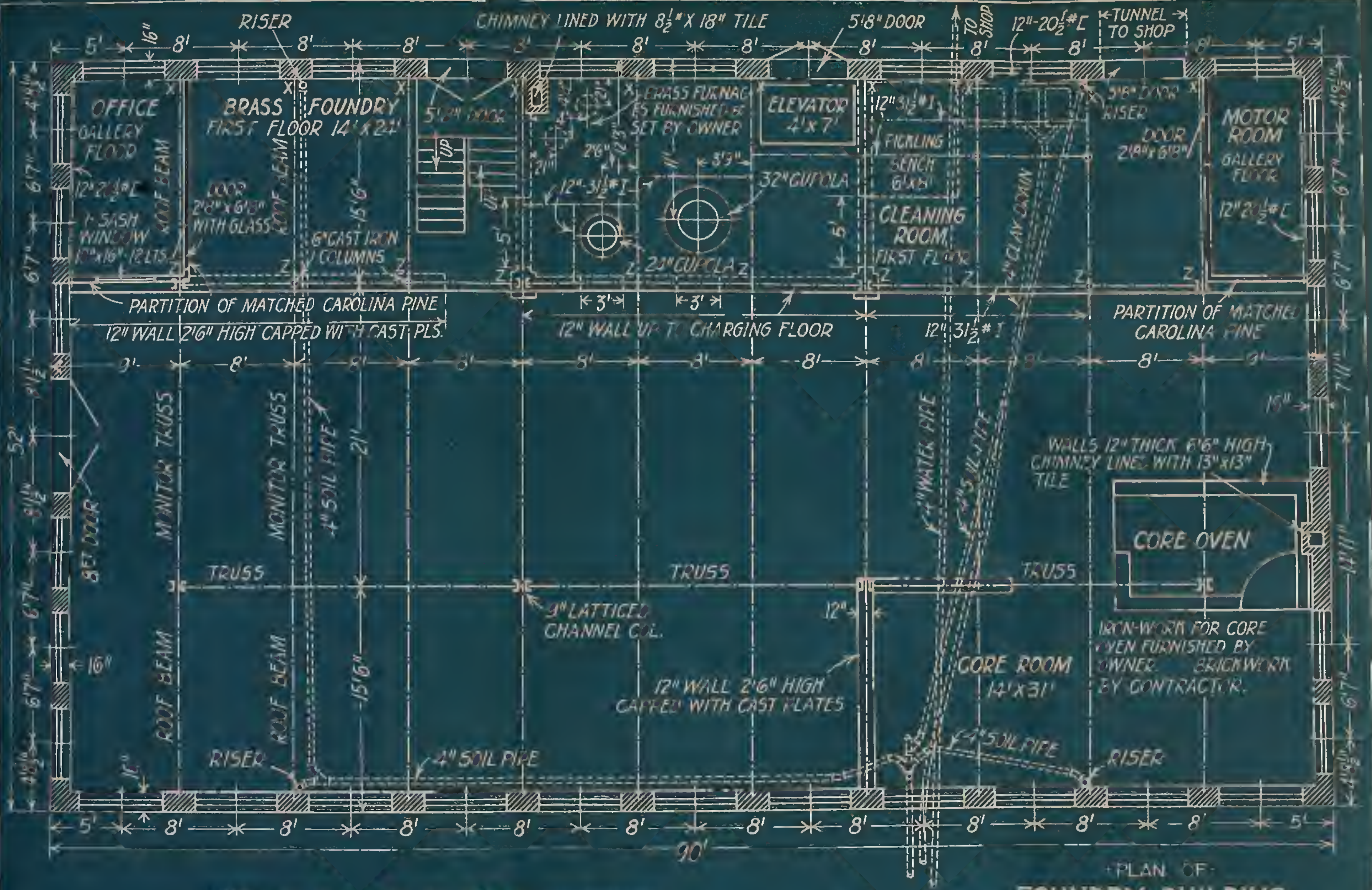


Fig. 2. Details of Angle Sections

Instead of giving in degrees and minutes the angle one piece makes with another, as is done in machine shop drawings, a small triangle is placed on the piece, as shown at the upper end of angle *D–3* and on its lower side. This means that the line



NOTE - AT X-Z ARE 12"-31½ # I'S SUPPORTING GALLERY AND CHARGING FLOORS.

XXXV

PLAN OF
FOUNDRY BUILDING
WORCESTER POLYTECHNIC INSTITUTE
Plans by C.E. Dept. ¼ INCH = 1 FOOT June 1912

on the gusset plate along which the rivet holes are to be placed rises from a base line $8\frac{11}{16}$ inches in 12 inches. The layout man accordingly measures off a base line on the gusset 12 inches in length and erects a perpendicular line on one end $8\frac{11}{16}$ inches in height. From this height he may scribe a line to the other end of the 12-inch base line and this is the gage line for the rivet holes. In all structural steel work the rivet holes are spaced along lines located a given distance from the back of the angle. These lines are termed *gage* lines and are not center lines in the usual sense. For example, in the view shown the reader will note that in the top member of the truss in the front view there are two gage lines and therefore two lines of rivets.

It will be observed that, while the top view of the truss is placed above the front view as in previous blueprints which we have studied, it parallels the slant of the truss. If a bottom view were given of this truss, it would show as if viewed from inside the truss; such a view is distinctly different from the bottom views already studied, and this point should be carefully noted in reading structural drawings.

PLATE XXXV

PLAN OF FOUNDRY BUILDING

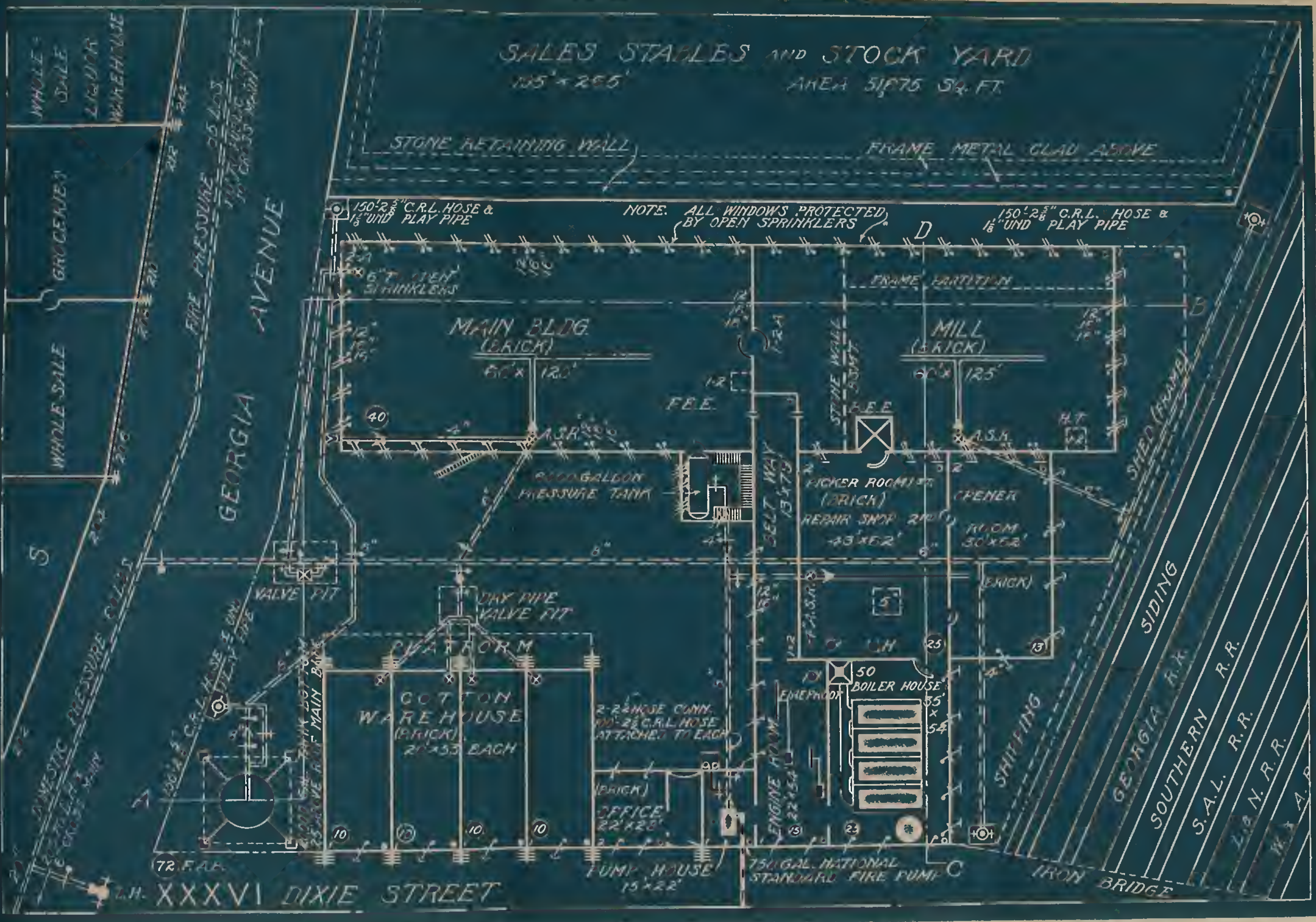
Plate XXXV shows the plan of a foundry building. While the blueprint is more than ordinarily complete, it fairly represents such plans. The walls of the building are of brick and the windows are the prominent features of the walls. The reader should observe that the outside dimensions of the building, the door sizes, and the thickness of the walls are given; the columns, posts, interior walls, and partitions are located; the center-to-center distances are given; the foundry equipment is given and its position located on the plan; all stairways are indicated; and room measurements are given. Attention is called to the method of representing the windows by means of two parallel lines placed across the openings in the brick wall and to the method of showing the doors swung partly open. The plan shows a gallery floor along one side of the building. On this floor are located the office of the foreman, the charging floor for the cupolas, the motor room, etc.; the gallery floor is supported partly by the 9-inch latticed channel columns and partly by a series of 6-inch round cast-iron columns. Three sets of doors are shown opening into the air and one opening into a tunnel to the shop. As a means of carrying off roof water and drainage from the pickling bed and cleaning room, a soil pipe line is shown. As most of this line of pipe is placed beneath the floor, it appears in the blueprint as a double dotted line. Two tile-lined chimneys are shown; one of these is for the brass furnace and one for the core oven. The core room is partly inclosed by means of a low wall capped with cast plates. The 8-foot door opens onto a driveway as do the two 5-foot 8-inch doors. These driveways and the street along the front of the building are not shown in the plan, but the street location could be assumed by the fact that the soil pipes, the clay drain, and the water pipes extend beyond the wall in a certain direction.

PLATE XXXVI

TYPICAL FIRE INSURANCE MAP

In fire insurance work the graphic description of a property has an important function; the custom is to show a plan or simple diagram of the insured properties, Plate XXXVI, adding certain simple devices for indicating such features of the building as may conveniently be described in this manner.

The map of a fire insurance risk gives the general location of the risk and its position relative to other risks. It also shows a scale drawing of the ground plan of the building, giving the dimensions, area, and, at the same time, a perfect idea of its general contour and the relation of the subdivisions of the building. By varying the thickness of the wall lines they are made to represent different kinds of walls. Unfinished or incomplete walls are represented by dotted lines; open spaces in the line indicate where the wall is interrupted or where a window opening occurs. Color is used to a large extent to indicate the different forms of construction; certain symbols, which follow in a measure the shapes of the things they represent, are used to shorten the description; and of course the use of initial letters is too well known to be more than mentioned. These symbols, it must be understood, are purely arbitrary but, having become established and recognized, they form the *symbol* language of the inspector and must be studied in a practical way in


SALES STABLES AND STOCK YARD
155' × 255'
AREA 51,875 SQ. FT.
STONE RETAINING WALL
FRAME METAL CLAD ABOVE
WHOLESALE LIQUOR WAREHOUSE
GROCERIES
WHOLE SALE
FIRE PRESSURE 6" C.I.L.S.
GEORGIA AVENUE
DOMESTIC PRESSURE 6" C.I.L.S.
150'-2½" C.R.L. HOSE & 1⅛" UND. PLAY PIPE
NOTE: ALL WINDOWS PROTECTED BY OPEN SPRINKLERS
150'-2½" C.R.L. HOSE & 1⅛" UND. PLAY PIPE
D
B
6" T. OPEN SPRINKLERS
MAIN BLDG. (BRICK)
60' × 120'
F.E.E.
40
A.S.R.
6000 GALLON PRESSURE TANK
BELT WAY 13×75
STONE WALL
FRAME PARTITION
MILL (BRICK)
60' × 125'
F.E.E.
A.S.R.
H.T.
PICKER ROOM 1ST (BRICK)
REPAIR SHOP 2ND
43' × 62'
OPENER ROOM
30' × 62'
(BRICK)
SHED (FRAME)
8"
6"
VALVE PIT
DRY PIPE VALVE PIT
PLATFORM
COTTON WAREHOUSE (BRICK)
20' × 55' EACH
2-2½" HOSE CONN. 100'-2½" C.R.L. HOSE ATTACHED TO EACH
(BRICK) OFFICE 22' × 28'
FIREPROOF
50
BOILER HOUSE
35' × 54'
ENGINE ROOM 22' × 54'
25
13
10
13
10
10
72 F.A.R.
15
22
PUMP HOUSE 15' × 22'
750 GAL. NATIONAL STANDARD FIRE PUMP
C
IRON BRIDGE
SHIPPING
SIDING
GEORGIA R.R.
SOUTHERN R.R.
S.A.L. R.R.
L. & N. R.R.
W. & A. R.R.
100'-2½" C.R.L. HOSE 1⅛" UND. PLAY PIPE
1ST RAIN LINE 8" ABOVE F.S. MAIN
S
F.H.
XXXVI DIXIE STREET

order to be recognized when presented. A few of these symbols and their description are given to convey some idea of the manner in which the map may be interpreted.

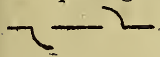
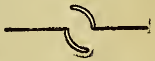
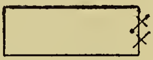
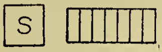
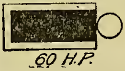
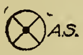
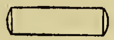
A solid thick line represents an independent wall. A solid thin line represents a party wall. A distinct break in the line representing a division or side wall indicates an opening made by a doorway or arch. A small curved line  or a short line at right angles indicates the presence of a fire door, the auxiliary line being placed on the side of the wall the door is on. An auxiliary line on each side indicates a fire door on each side of the walls. A double curved line  is used to represent a standard fire door.  A little black dot on the inside end of a window line indicates a window opening on that side of two adjoining walls. If the black dot is missing, it means that there is no window on this floor. A single curve over the end of the window line represents a non-standard fire shutter. A straight line indicates the presence of wire glass. The initial H within a hollow square is used to represent a hoistway or hatch.  The letter S within a hollow square is used to represent a stairway. A stairway is also represented by a rectangular outline crossed by straight lines supposed to represent the stair steps. A solid black oblong figure represents a horizontal boiler, while a solid black circle represents a vertical boiler. A thin line around the solid black oblong figure  and the margin colored in red represents a horizontal steam boiler which is bricked in. A small thin-lined circle with diagonals and a black dot at their intersection  indicates an automatic sprinkler riser. A sprinkler pressure tank is represented thus .

Plate XXXVI is a copy of a map issued in connection with the adoption of these symbols by the Fire Underwriters Uniformity Association and brings into use practically all the symbols needed in maps of this character. While this type of blueprint is special, the ability to read it is of value.

PLATES XXXVII TO XLI

TYPICAL PLANS OF A TWO-STORY RESIDENCE*

The average person looking at a building has little conception of the many drawings it takes to fully illustrate the structure on paper. Many trades are concerned in the rearing of the building. Each one of them must be told in the drawings what portion of the work they have to execute, and their work must be clearly and fully illustrated so that it will fit in with all the other work without friction or confusion. To bring about this result, it is of the utmost importance that the drawings be as complete as they can be made —nothing left to chance or guesswork and all sides of the problem represented. Take, for instance, a staircase; one reason for difficulties occuring time and again in constructing this important part of a building is the fact that the stairs have been shown only from one view. If it had been drawn out from different angles showing the various sections besides the elevations, then any mistakes like lack of headroom would have been discovered while making the drawings and not during the process of building. The writer speaks from experience in this matter.

Five of the principal drawings of a set of plans for a two-story residence have been selected to give a good idea of the methods employed to illustrate to the builder what he is to do.

A word must be said here on the importance of the lettering of a drawing. Anyone familiar with drawings knows that some drawings are more easily read than others. A first glance at a drawing should tell the subject illustrated. Next in importance on a plan would be the designation of the rooms. In still smaller type would be shown all the descriptive matter. The disposition of the dimension figures must be such as not to confuse the eye and they must not interfere with the descriptive matter. The main dimensions should stand out clearly. Bearing these points in mind will assist considerably in one's intelligent reading of a drawing.

First-Floor Plan. Plate XXXVII shows the first-floor plan of the residence. At the right of the drawing is a diagram called "key to materials." This shows the method used to indicate the various building materials. This "key" applies to all the drawings.

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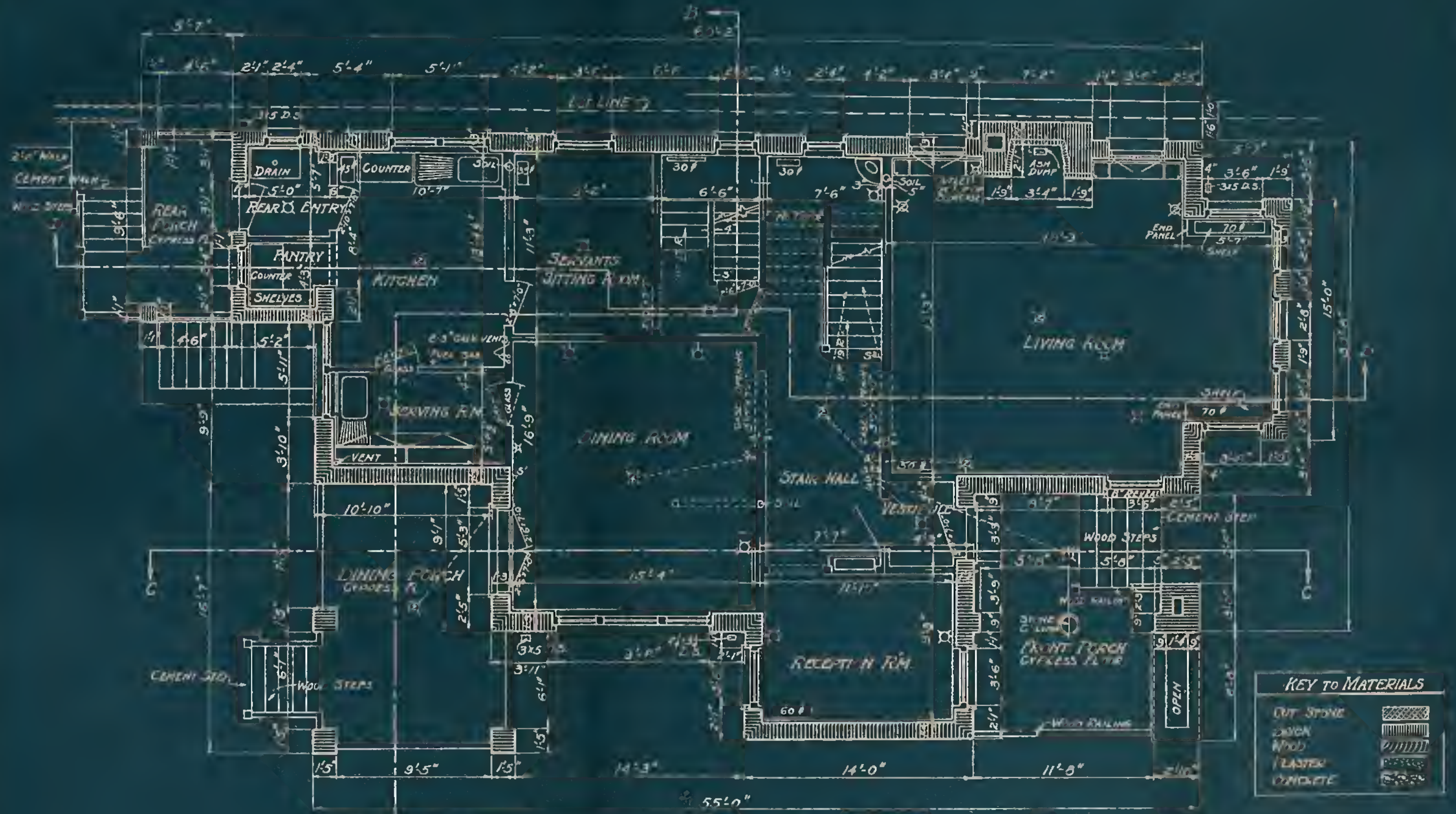
* Prepared by H. V. Von Holst, Architect, Chicago.



FIRST FLOOR PLAN

XXXVII

There is no recognized standard for indicating materials in a certain way; each architect's office has its own individual method of indication. On the plan it will be seen that the brick walls stand out very clearly due to the indication, thus enabling one to read the general arrangement of the house without difficulty. The interior frame and plastered partitions are shown merely by two lines. Note the difference in showing a double-hung window from a swinging window. The double-hung window has a box frame which is recessed into the wall. The distance that this frame sets back from the outside wall line is called the *reveal.* In this house all the reveals are 8 inches. This is one distinguishing feature between a solid-brick house and a brick-veneer house. In the latter the reveal cannot be more than 4 inches. Swinging windows are shown on either side of the fireplace in the living room. Here there is no recess in the wall, as a plank frame is used instead of a box frame. These windows are double-swinging, or casement, windows swinging into the room, as shown by the slanting lines. Doors are shown by describing an arc of a circle with the center at the point where the door is hinged and drawing a line from the center to the edge of the arc. Where there is an opening without doors between rooms and the top of the opening is brought down below the ceiling line, it is called a cased opening and dotted lines indicate this fact. Lights, radiators, and dimension lines are shown in watered-ink lines in order that they may print lighter and may not confuse the drawing by showing too many lines of the same weight. Ceiling lights and wall brackets are shown by a circle; the wall bracket has a line tying it to the wall. Floor and base outlets are shown by a small rectangle. If more than one light is to be on a fixture, the fact is marked in the circle or rectangle. Switches are indicated by the letter *S* and a dotted line running to the light which it controls. Where a switch is marked *S*-3 it denotes a three-way switch. The radiators are drawn to the proper size and the number of square feet of radiation is marked in the rectangle. The method used in dimensioning the plan is easily followed. Windows are figured between finished brick jambs; in a frame building the size of the glass only is given. The inside partitions are figured to the center of the partition. The ordinary plastered stud partition is slightly less than 6 inches but for convenience sake it is figured at 6 inches. If no dimension is given, it is a 6-inch partition. Where the partition has to be made wider to accommodate soil pipes it ought to be shown or figured. The same applies if the partition is less than 6 inches as in the case where the studs are set sideways, making only a 4-inch partition. It does not make as stiff a wall but sometimes is desirable on account of saving space. In this plan the walls are figured 1 foot 3 inches thick, which is the distance from the outside of the brick wall to the inside of the plaster wall. This allows 1-inch furring strips on top of the 13-inch brick wall.

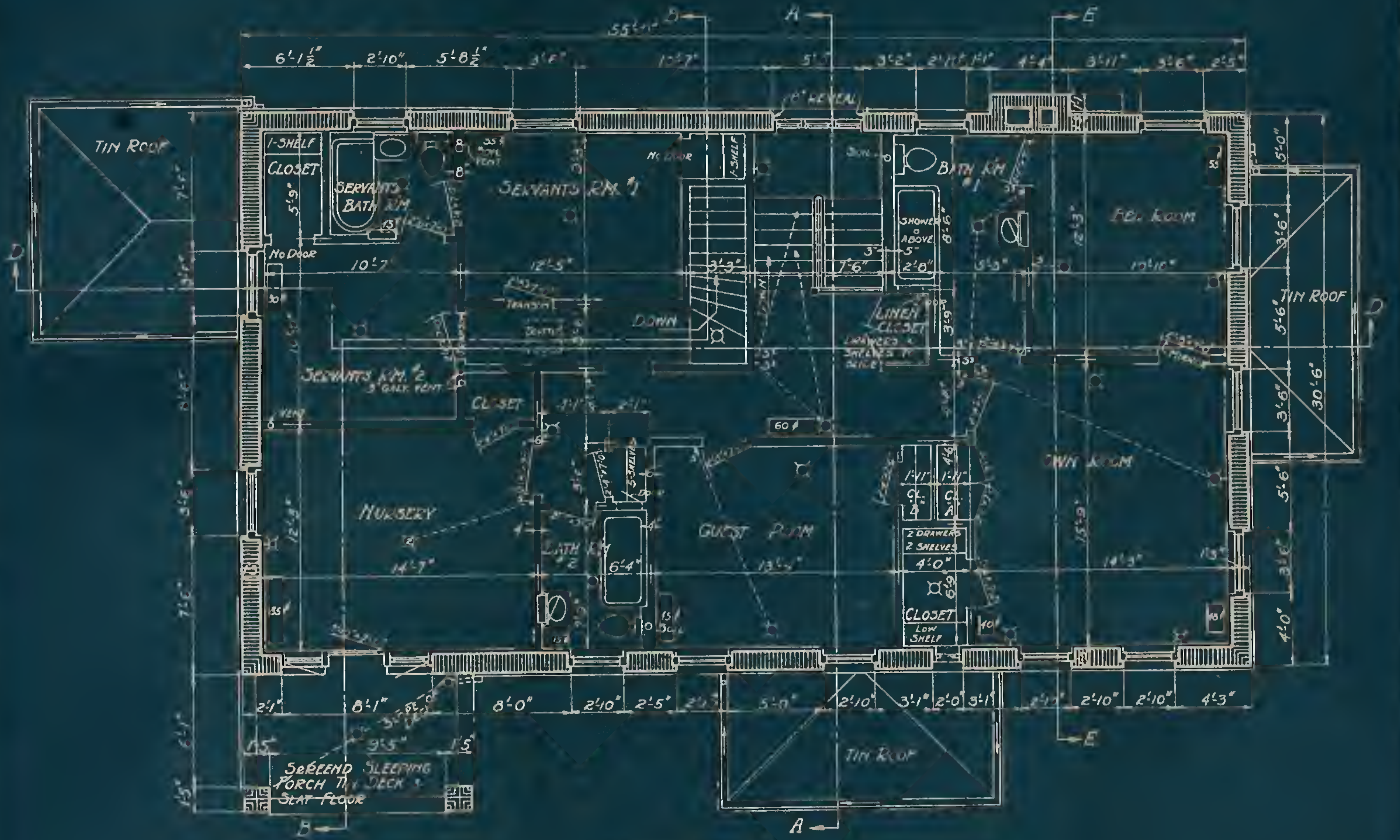
The plan shows lines marked *B–B, C–C, D–D* with a light dash and dot. These indicate the vertical sections through the building that are shown on separate drawings, the direction of the arrows showing which way the observer is looking; for instance, section *C–C* is taken through the dining porch, dining room, stair hall, vestibule, and front porch, looking toward the south.

Second=Story Plan. Plate XXXVIII shows the second-story plan, the roofs over the one-story portions being shown.

Attention is called to a feature in this plan where the servants' bedrooms and bathroom are on the second floor instead of in a hot attic, which is the usual way in this type of house. The attic has been omitted entirely, there being only a scuttle in the hall by means of which the space under the roof can be reached.

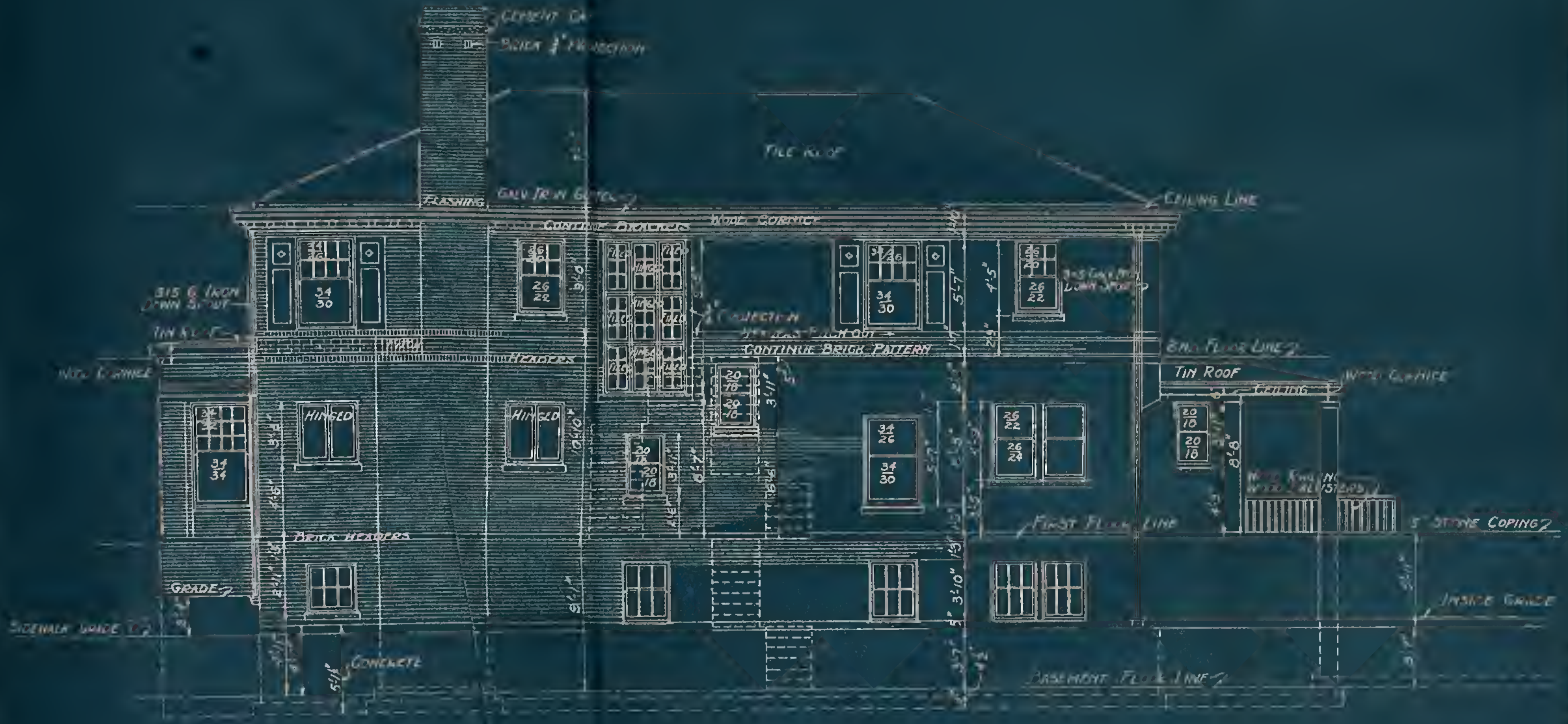
North Elevation. Plate XXXIX shows the north elevation. The portions of the building below the finished grade are indicated in dotted lines. The stairs too are brick joints drawn in with light lines. All dimensions are figured from the sidewalk grade and the basement floor. Window-glass sizes give as first dimension the width and then the height, i.e., 26/20 means glass 26 inches wide and 20 inches high. The floor lines given are the finished floors unless otherwise noted. Window heights are figured from top of slope sill to bottom of window head.

Exterior and Interior Details. Plate XL shows the exterior and interior details of the residence. Portions of the building are drawn on a larger scale to explain more fully what is required. Thus on the left-hand side of the sheet is a corner of the front of the building showing half of the entrance arch. At the second-story window is interposed a plan through the corner at the second-



SECOND FLOOR PLAN

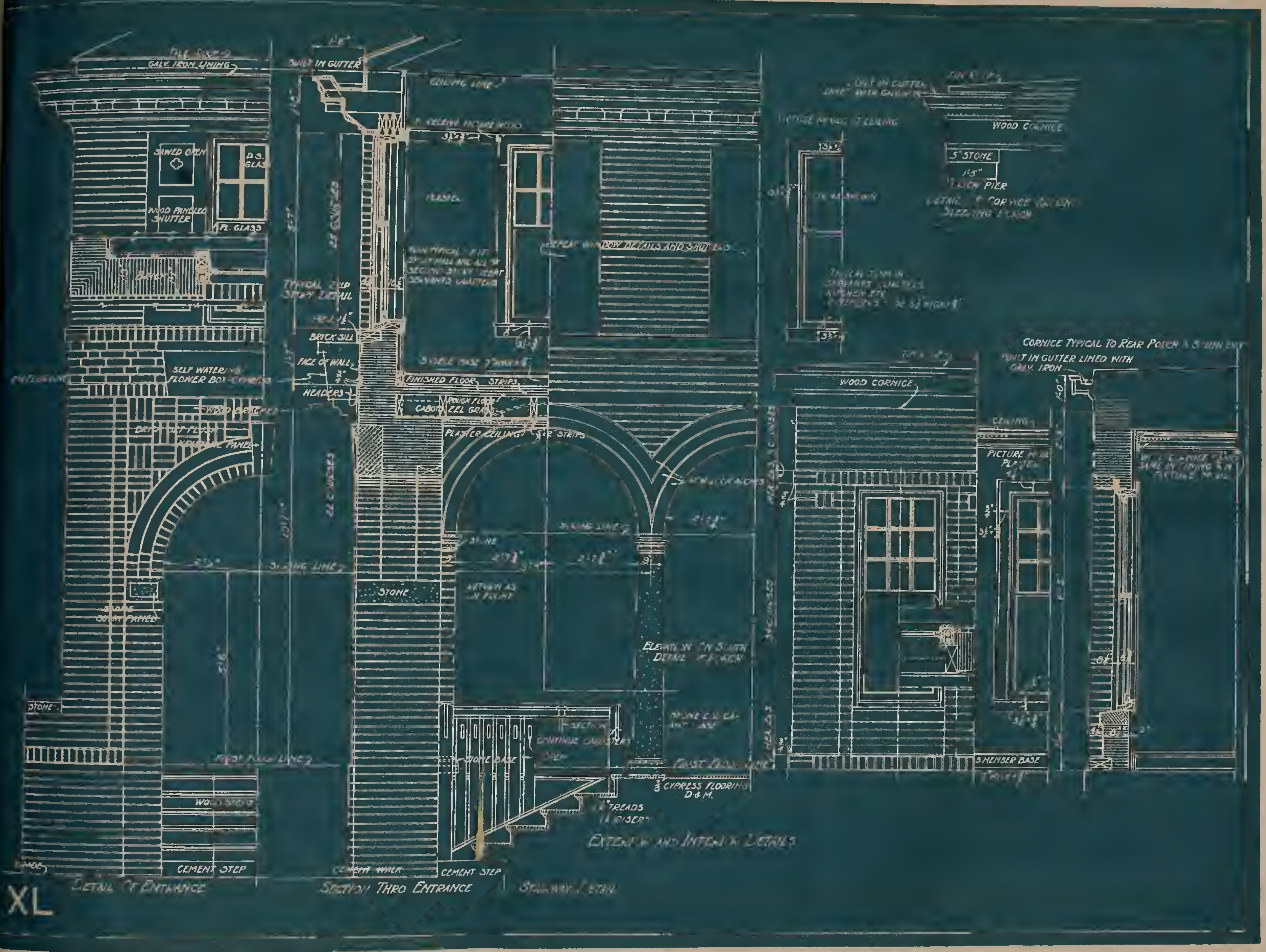
XXXVIII



NORTH ELEVATION

XXXIX

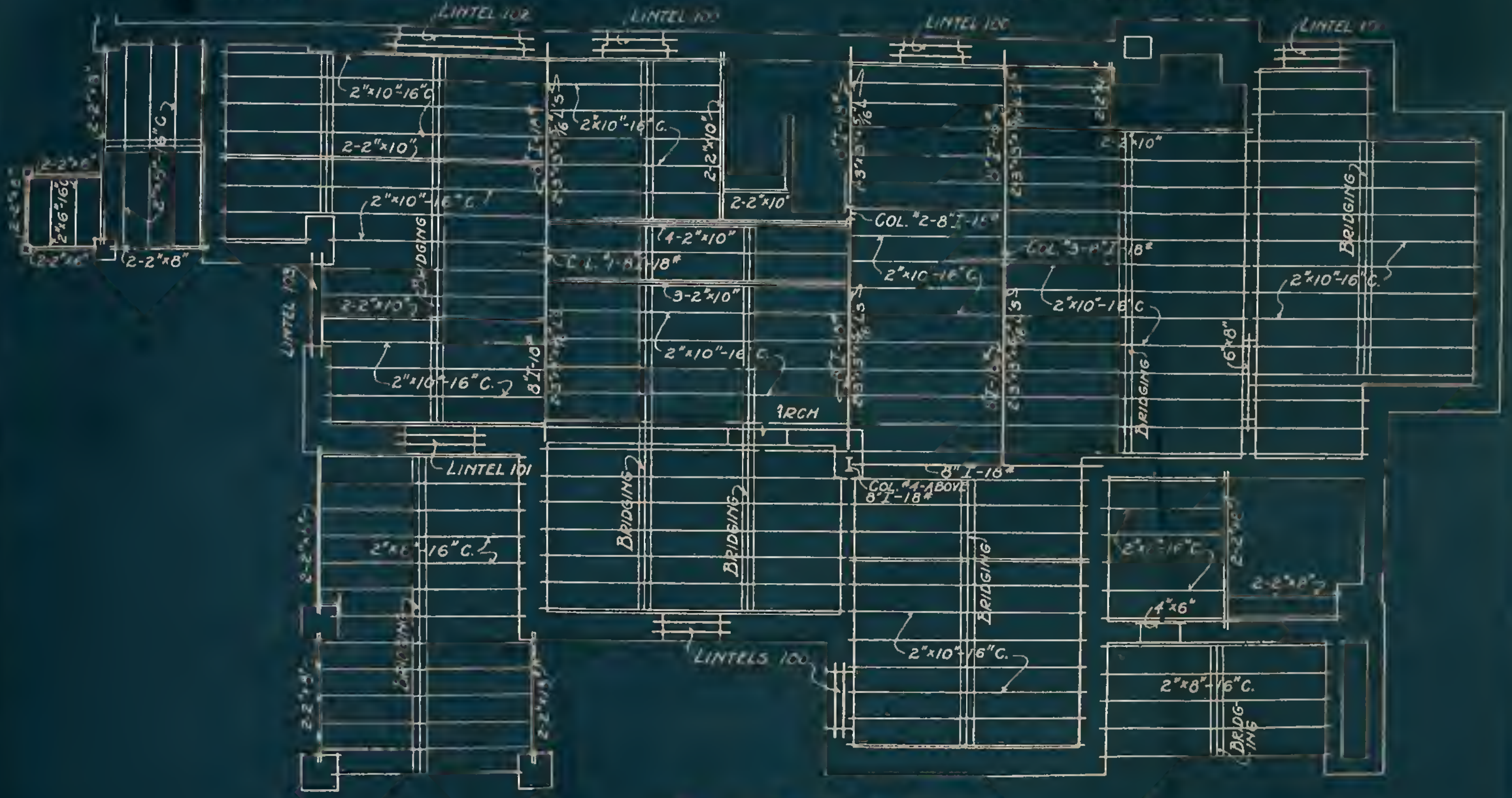
XL



EXTERIOR AND INTERIOR DETAILS

NOTE:
ALL 6" I'S TO HAVE 9" BEARING ON WALL-TO HAVE WING ANGLE ANCHORS-2-6"×3½"×3/8" L'S-5" LG AND 8"×6"×½" ST. PLS.
ALL COLUMNS TO HAVE 12"×15"×3/4" ST. BASE PLS. WITH 6"×3½"×3/8" BASE L'S AND BRACKET CONNECTIONS FOR I-BEAMS AND ANGLE BRACKETS WHERE REQUIRED FOR WOOD BEAMS.
ALL WOOD JOISTS TO BE SECURELY TIED TOGETHER AT GIRDERS WITH W.I. TIES-WOOD JOISTS TO BE PROPERLY ANCHORED INTO BRICKWORK.

LINTELS 100- 2 PAIRS 3½"×3½"×5/16" L'S-4'-2" LG-RIV.
LINTELS 101- 2 PAIRS 3½"×3½"×5/16" L'S-4'-6" LG-RIV.
LINTELS 102- 2-6" ['S-8#-2-3½"×3½"×5/16" L'S-RIV.-7'-6" LG-['S-7"-2 TO 8-STD. C.I. SEPS.
LINTELS 103- 2-6" ['S-8#-2-3½"×3½"×5/16" L'S-RIV. 5'-0" LG-['S-7"-8 TO 8-STD. C.I. SEPS.



FIRST FLOOR FRAMING PLAN

XLI

story window level. Alongside of this elevation is a section taken through the center of the entrance arch and the wall above. It shows the side archways in elevation beyond the dash-and-dot line. Next is a detail of a portion of the front bay window with a plan through the window jamb interposed. Alongside of this exterior is a view of the interior of the bay window showing the base, window trim, and cornice. Finally comes the vertical section through the bay window, thus giving a complete picture of this feature of the house. Above the bay-window drawing is a detail of half a window showing the trim in the servants' rooms, and to the right of this a detail of the cornice around the sleeping porch. The student should follow these details on the floor plans in order to clearly understand what portions of the building are being shown in these details. Details must be shown in parts as it would take too much time and paper to draw a feature completely when half of the feature or less will explain how it is to be built.

First=Floor Framing Plan. Plate XLI shows the first-floor framing plan. Separate framing plans are not always made for a building of this size, but where steel is used for the main supports it is a great help and causes less confusion on the general plans to have the separate framing drawings. The walls and openings and all wood beams are shown by light lines. All steel work is shown in heavy lines. Each wooden joist is indicated by a line. The width and depth of the joist are given, and distance that they are spaced on centers. Where there are three lines close together, they are marked 3, then the width of joist and depth. The steel lintels over the windows are marked with a number and the size given in the upper left-hand corner.

In conclusion let it be said that it takes patience, and a great deal of it, to draw a set of plans for any building and make it so that all the ins and outs of the building can be worked out in concrete form, and so also it takes patience to read a house plan and follow it through in all its details and not *miss* some important items.

Plans are often incomplete and inaccurate or faulty and the reader of a plan must train himself to become so adept in reading a plan that he can not only picture for himself the building as it is intended, but can get a complete picture even though some of the details may possibly be wrongly shown, or not shown at all.

BLUEPRINT READING

Read Carefully: Place your name and full address at the head of the paper. Any cheap, light paper like the sample previously sent you may be used. Do not crowd your work, but arrange it neatly and legibly. *Do not copy the answers from the Instruction Paper; use your own words, so that we may be sure you understand the subject.*

1. What is a blueprint?

2. Describe the process of making a blueprint.

3. What should a workman understand in order to read a blueprint correctly?

4. How would you arrange to show a view of large work on a small sheet of paper?

5. State the meaning of the following symbols: L.H., C.I., O.H.S. and F.A.O.

6. Give the symbols for the following: Finished Surface, Diameter, Pipe Tap and Tool Steel.

7. Sketch a conventional screw-thread as it is generally shown on a blueprint.

8. Show by sketch, with dimensions, an outline of the teeth, or threads, on a worm and hobbing cutter.

9. In tracing the location of parts, holes, etc., in what general position will they be in the top or end view as compared to their position in the front view?

10. Read from Plate XIX just which surfaces are to be machined.

11. What is tolerance, and how is it shown on a blueprint?

12. In the armature punching, Plate XXIII—2, what is the outside diameter, and how many slots are there?

13. From what kind of drawings are the blueprints in Plate XXIX made, and what is the advantage of these small prints?

14. Explain third-angle projection, illustrating by sketch.

15. Does Plate XXXII represent third-angle or first-angle projection?

16. Read the greatest diameter and total length of the spindle shown in Plate XXXIII, and state what kind of keys are used.

17. What are gage lines, as used in roof-truss blueprints?

18. Read the outside dimensions and thickness of walls of the foundry building shown in Plate XXXV.

19. What is the general purpose of such a blueprint as Plate XXXVI?

20. Represent by sketches a horizontal boiler, a vertical boiler, and a stairway.

After completing the work, add and sign the following statement:
I hereby certify that the above work is entirely my own.
(Signed)

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